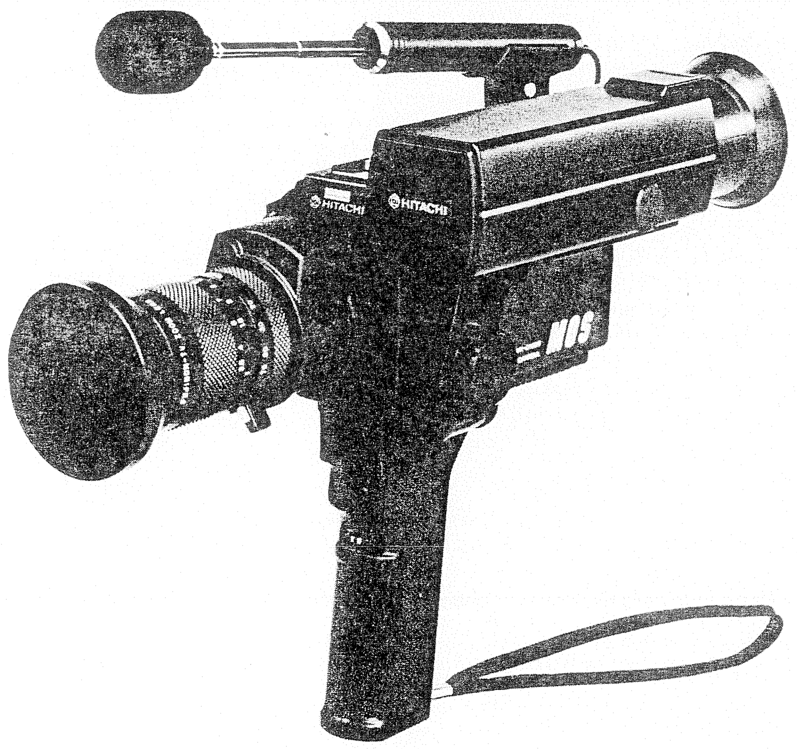
V01302

HITACHI SERVICE MANUAL

TK No. 1651E

VK-C1000(U,C)



SAFETY PRECAUTION

The following precautions should be observed when servicing.

1. Since many parts in the unit have special safety-related characteristics, always use genuine Hitachi replacement parts. Especially critical parts in the power circuit block should not be replaced with other makes.
   Critical parts are marked with ⚠ in the schematic diagram, and circuit board diagram.
2. Before returning a repaired unit to the customer, the service technician must thoroughly test the unit to ascertain that it is completely safe to operate without danger of electrical shock.

X-RAY RADIATION

The primary source of X-ray radiation in this viewfinder is the picture tube. The tube used in this viewfinder is especially constructed to limit X-ray radiation emission. For continued X-ray radiation protection, the replacement tube must be the same type as the original, Hitachi approved one.

SPECIFICATIONS AND PARTS ARE SUBJECT TO CHANGE FOR IMPROVEMENT

COLOR VIDEO CAMERA

November 1981 TOKAI WORKS

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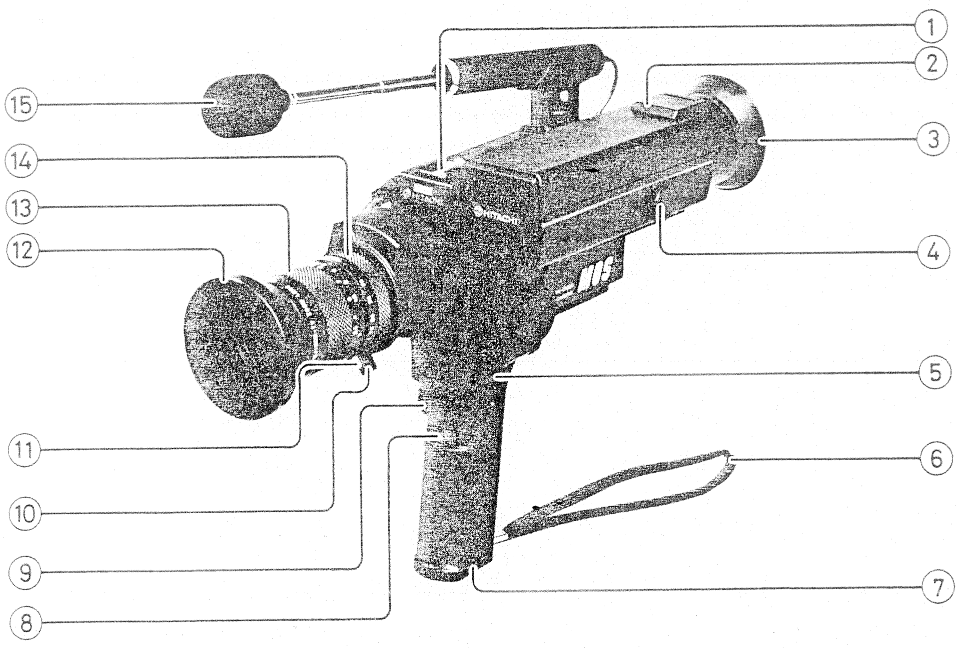
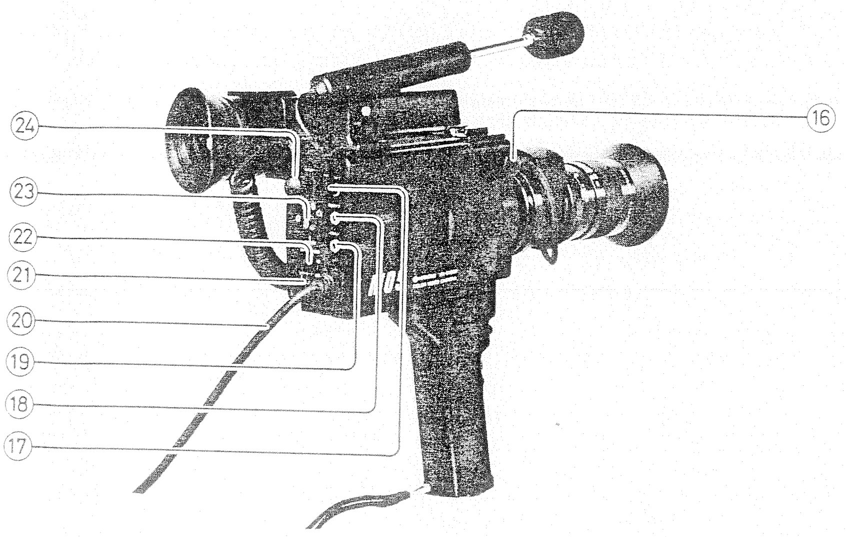
KEY TO ILLUSTRATIONS



1. Adaptor shoe
2. Electronic viewfinder
3. Eye cup
4. Blind screw
5. Securing Nut for Grip
6. Band strap
7. Grip
8. Power zoom switch
9. Remote control switch
10. Zoom lever
11. Macro button
12. Zoom lens
13. Focus adjust ring
14. Zooming ring
15. Boom microphone



16. Lens connection cord
17. Boom microphone connection terminal
18. External microphone jack
19. Earphone jack
20. Camera cable
21. Power save switch
22. White balance check switch
23. White balance control knob
24. Electronic viewfinder connection terminal

SPECIFICATIONS

Color system:	NTSC
Image sensor:	2/3 inch single plate color MOS image sensor
Number of Scanning system:	525 lines 2:1 interlacing
Synchronization system:	Internal synchronization
Video output:	1 Vp-p 75Ω (unbalanced)
Video S/N ratio:	46 dB or more
Resolution:	260 lines or more
Audio input:	Microphone –67 dB high impedance
Audio output:	Line –20 dB low impedance
Automatic sensitivity control:	100 – 100,000 lux
Minimum luminance required:	100 lux (Recommended luminance: 500 lux or more)
Standard object luminance:	2000 lux
Viewfinder:	Electronic viewfinder
Lens (accessory):	F1.4 f=12.5 –75mm zoom (x6) (Auto iris power zoom with macro mechanism, filter dia. 52 mm C mount)
Microphone:	Unidirectional electret condenser microphone
Power supply:	DC 12V
Power consumption:	5.3W Camera 3.6W (Electronic viewfinder 1.7W)
External dimensions:	5.8(W) x 10.0(H) x 15.5(D) cm (Lens, electronic viewfinder, grip, microphone not included) 16.5(W) x 30.3(H) x 31.0(D) cm (When the electronic viewfinder is in its highest position. Lens, electronic viewfinder, grip, microphone included)
Weight:	1.1 kg (electronic viewfinder, grip, microphone not included) 1.7 kg (electronic viewfinder, grip, microphone included)
Accessories:	Electronic viewfinder x 1 Boom microphone x 1 Bracket x 1 Grip x 1 Electronic viewfinder connection cable x 1
Other item:	Camera terminal: Round 10P connector

DISASSEMBLY

1. **Grip, boom microphone, zoom lens (Fig. 1)**
    1) Remove the grip installation screw. (Grip)
    2) Remove the boom microphone installation screw. (Boom microphone)
    3) Remove the lens cable, and then turn the zoom lens in the direction of the arrow to remove it. (Zoom lens)

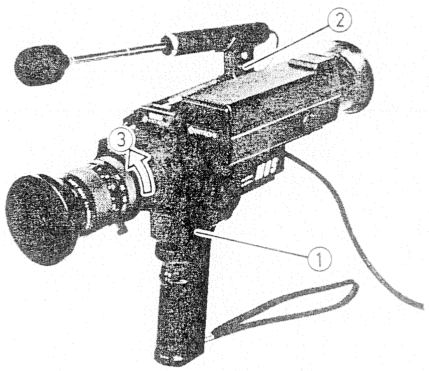


Fig. 1

2. **Top cover (Fig. 2)**
    1) Remove the screw.
    2) Remove the shoe spring installation screw to remove shoe spring.
    3) Remove 2 accessory shoe fixing screws at the bottom of the shoe spring.
    4) Move the top cover in the direction of the arrow to remove it.

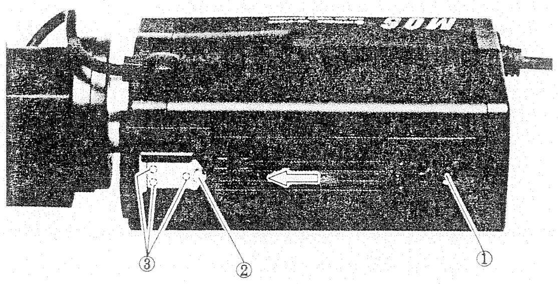


Fig. 2

3. **Side case (R, L) (Fig. 3)**
    1) Remove the grip, boom microphone, top cover (Refer to items 1, 2)
    2) Remove 4 screws (Fig. 3-1)
    3) Remove 4 screws (Fig. 3-2)
    4) Remove the side case in the direction of the arrow.

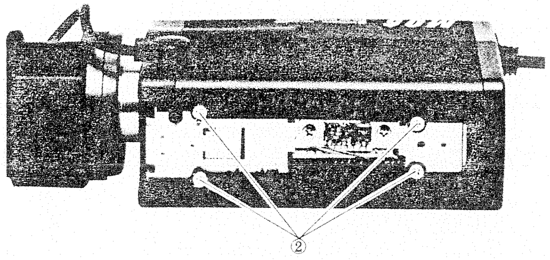


Fig. 3-1

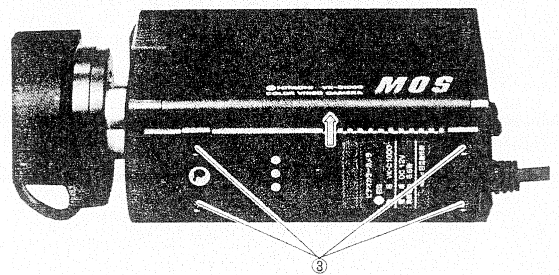


Fig. 3-2

4. **Switch panel (Fig. 4)**
    1) Remove the grip, boom microphone, top cover and side case (R, L). (Refer to items 1, 2, 3)
    2) Remove the screw.
    3) Remove 3 nuts for the exclusive microphone, external microphone and earphone jack.

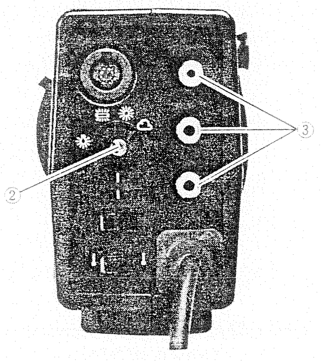


Fig. 4

5. **I Circuit board (Fig. 5)**
    1) Remove the grip, boom microphone, top cover and side case (R, L). (Refer to items 1, 2, 3)
    2) Remove the shield plate fixing screw to open the shield plate. (Fig. 5-1) (VK-C1000(C) only)
    3) Remove 2 screws.
    4) Pull out the I board in the direction of the arrow (④ - 1), insert a minus (—) screwdriver between the connector of the MO board and the grooves (④ - 2) on both sides of I board. When the I board is pulled out to some extent, remove it in the direction of the arrow (④ - 3). (Fig. 5-2)

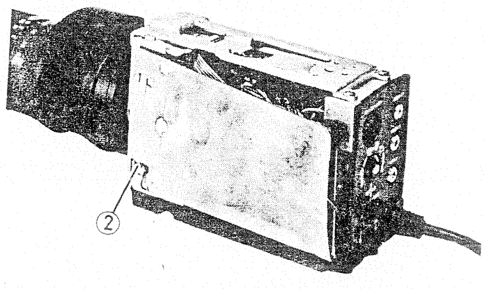


Fig. 5-1

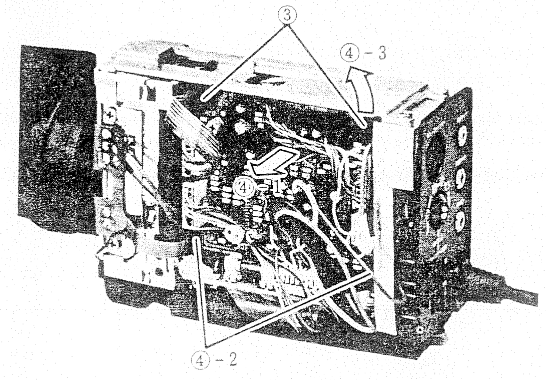


Fig. 5-2

6. **M circuit board (Fig. 6)**
   1) Remove the grip, boom microphone, top cover and side case (R, L). (Refer to items 1, 2, 3)
   2) Remove 2 shield fixing screws to open the shield plate. (Fig. 6-1) (VK-C1000(C) only)
   3) Remove 2 screws.
   4) Pull out the M board in the direction of the arrow (④ - 1), insert a minus (–) screwdriver between the connector of the MO board and grooves (④ - 2) on both sides of the M board. When it is pulled out to some extent, remove the M board in the direction of the arrow (④ - 3). (Fig. 6-2)

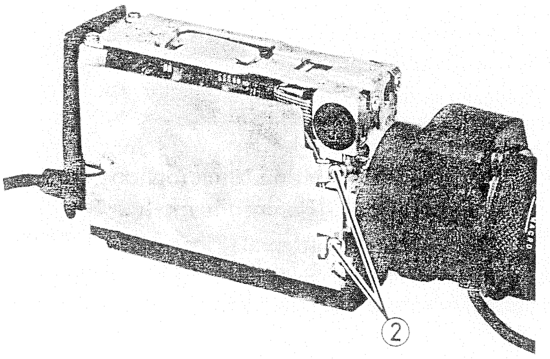


Fig. 6-1

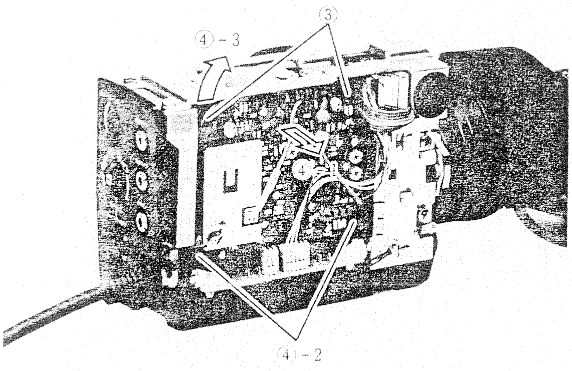


Fig. 6-2

7. **L circuit board (Fig. 7)**
   1) Remove the grip, boom microphone, zoom lens, top cover and side cover (L, R). (Refer to items 1, 2, 3)
   2) Remove 4 screws to remove the frame in the direction of the arrow (② - 1).
   3) Insert a minus (–) screwdriver between the connector of MO board and grooves (③ - 1) on both sides of the L board to remove the L board in the direction of the arrow (③- 2).

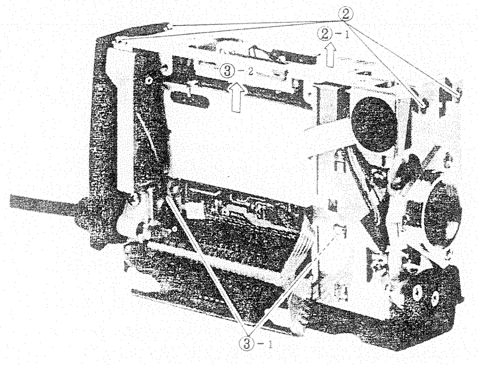


Fig. 7

8. **SP block (Fig. 8)**
   1) Remove the grip, boom microphone, zoom lens, top cover and side case (L, R). (Refer to items 1, 2, 3)
   2) Remove the I board, M board and L board. (Refer to items 5, 6, 7)
   3) Remove 2 screws.

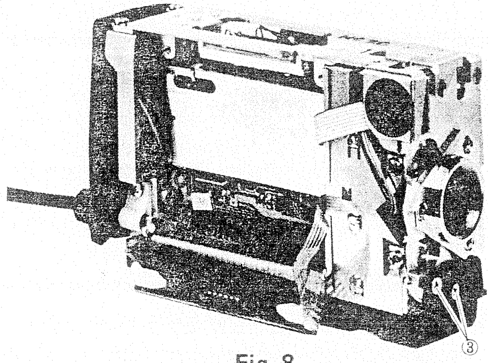


Fig. 8

9. **MO circuit board (Fig. 9)**
   1) Remove the grip, boom microphone, top cover, side case (L, R) and switch panel. (Refer to items 1, 2, 3, 4)
   2) Remove the I board, M board, L board and SP block.

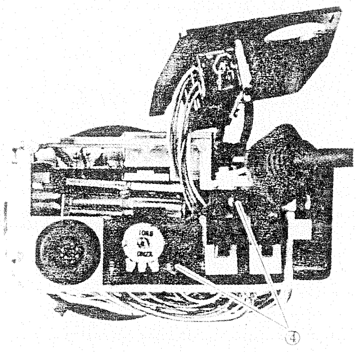


Fig. 9

(Refer to items 5, 6, 7, 8)

3) Remove 2 board bracket fixing screws and the MO board connector fixing screw.
4) Remove 2 screws.

10. V control circuit board (Fig. 10)

1) Remove the grip, boom microphone, zoom lens, top cover and side case (L, R). (Refer to items 1, 2, 3)
2) Remove the I board, M board, L board and SP block. (Refer to items 5, 6, 7, 8)
3) Remove 2 bracket fixing screws and the MO PC Board connector fixing screw.
4) Remove 2 screws.

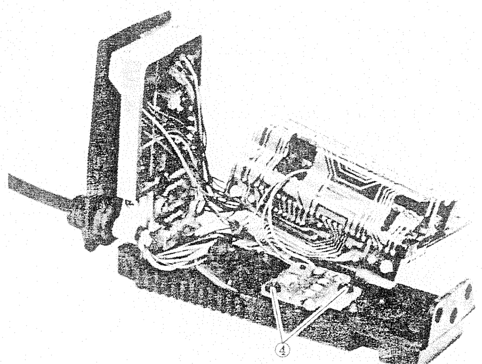


Fig. 10

11. PC circuit board (Fig. 11)

1) Remove the grip, boom microphone, top cover and side case (L, R). (Refer to items 1, 2, 3)
2) Remove the shield plate fixing screw to open the shield plate.
3) Remove the screw.

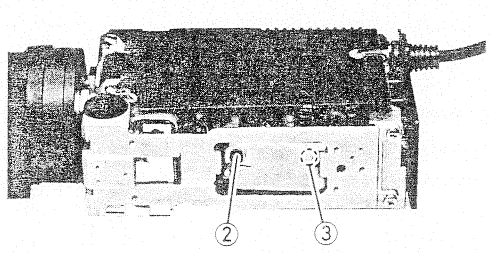


Fig. 11

12. EVF (Electronic viewfinder)

12-1 Bottom case E (Fig. 12-1)

1) Remove 2 screws and the screw.
2) Remove the bottom case E in the direction of the arrow.

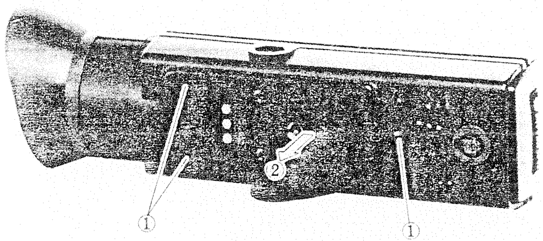


Fig. 12-1

12-2 E1 circuit board, E2 circuit board, LED circuit board (Fig. 12-2)

1) Remove the bottom case E. (Refer to item 12-1)
2) Lift the front cap in the direction of the arrow to remove it.
3) Remove the E1 board, E2 board and LED board in the direction of the arrow.

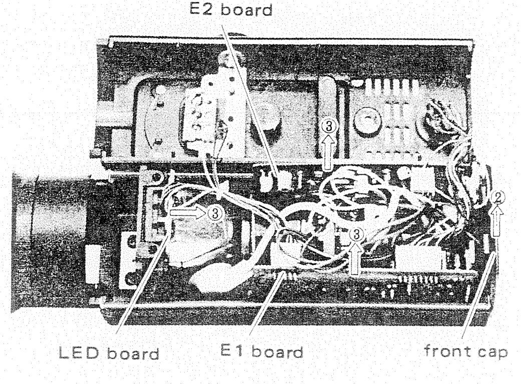


Fig. 12-2

12-3 CRT (Fig. 12-3)

1) Remove the bottom case E. (Refer to item 12-1)
2) Remove the E1 board, E2 board and LED board.
3) Remove the CRT socket.
4) Remove the CRT fixing ring screw.
5) Remove 2 CRT fixing screws to pull out CRT in the direction of the arrow.

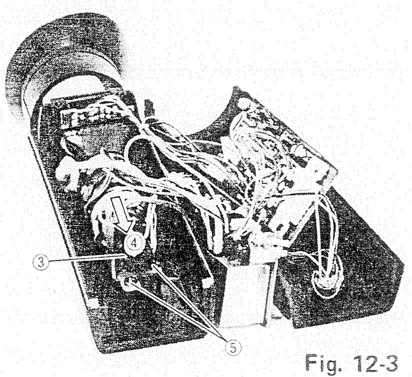


Fig. 12-3

12-4 Upper case

1) Remove the bottom case E. (Refer to item 12-1)
2) Remove the E1 board, E2 board and LED board. (Refer to item 12-2)
3) Remove the CRT. (Refer to item 12-3)

12-5 Connector circuit board (Fig. 12-4)

1) Remove the bottom case E. (Refer to item 12-1)
2) Remove knob and screws to remove the EVF bracket at the back of the bottom case E.

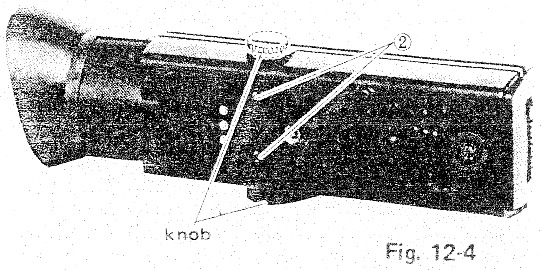


Fig. 12-4

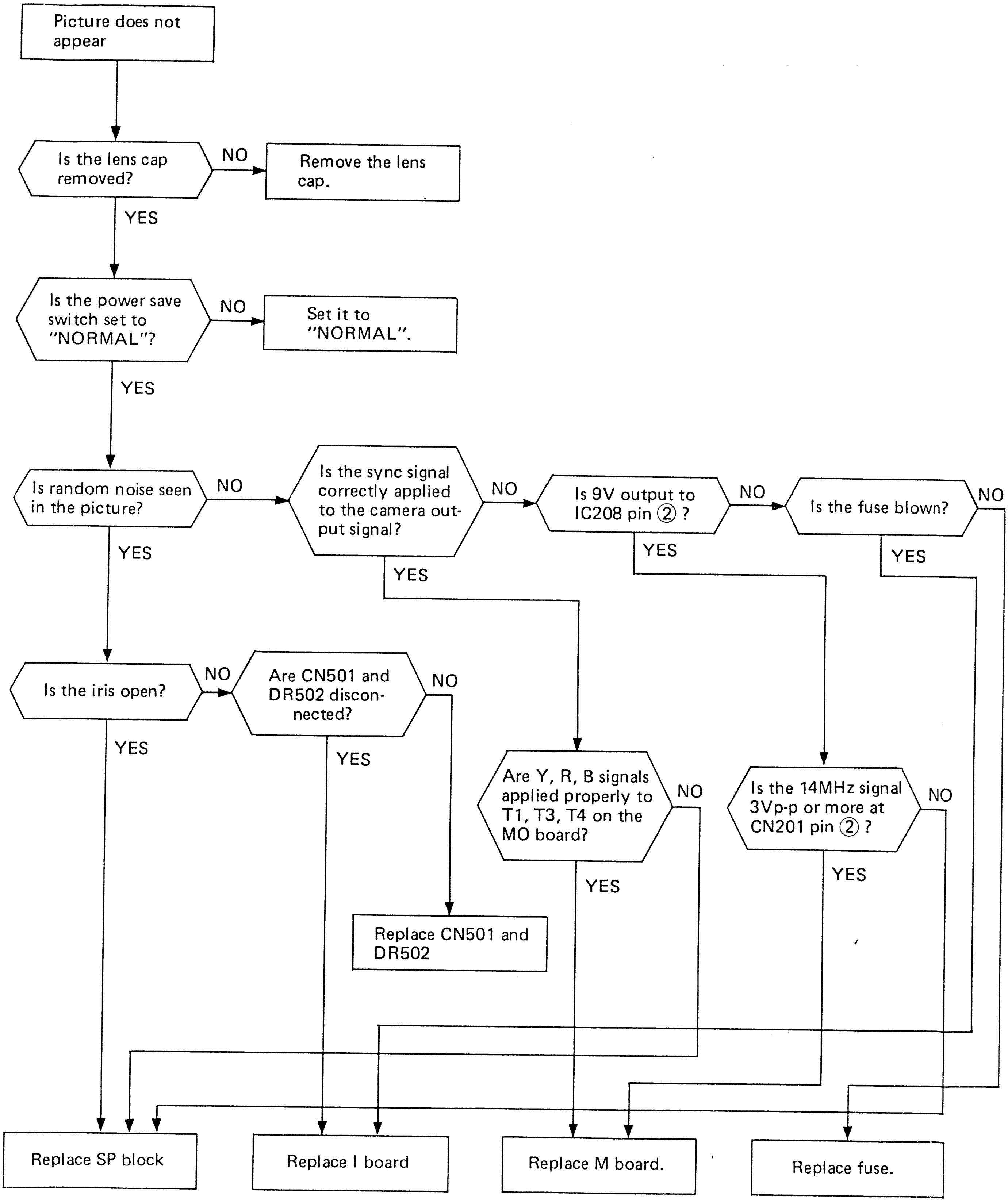
TROUBLESHOOTING

Check the following 2 items before checking the camera.

(1) Connections between equipment
Pay attention to the termination condition, type of cables used and operation switch positions, etc.

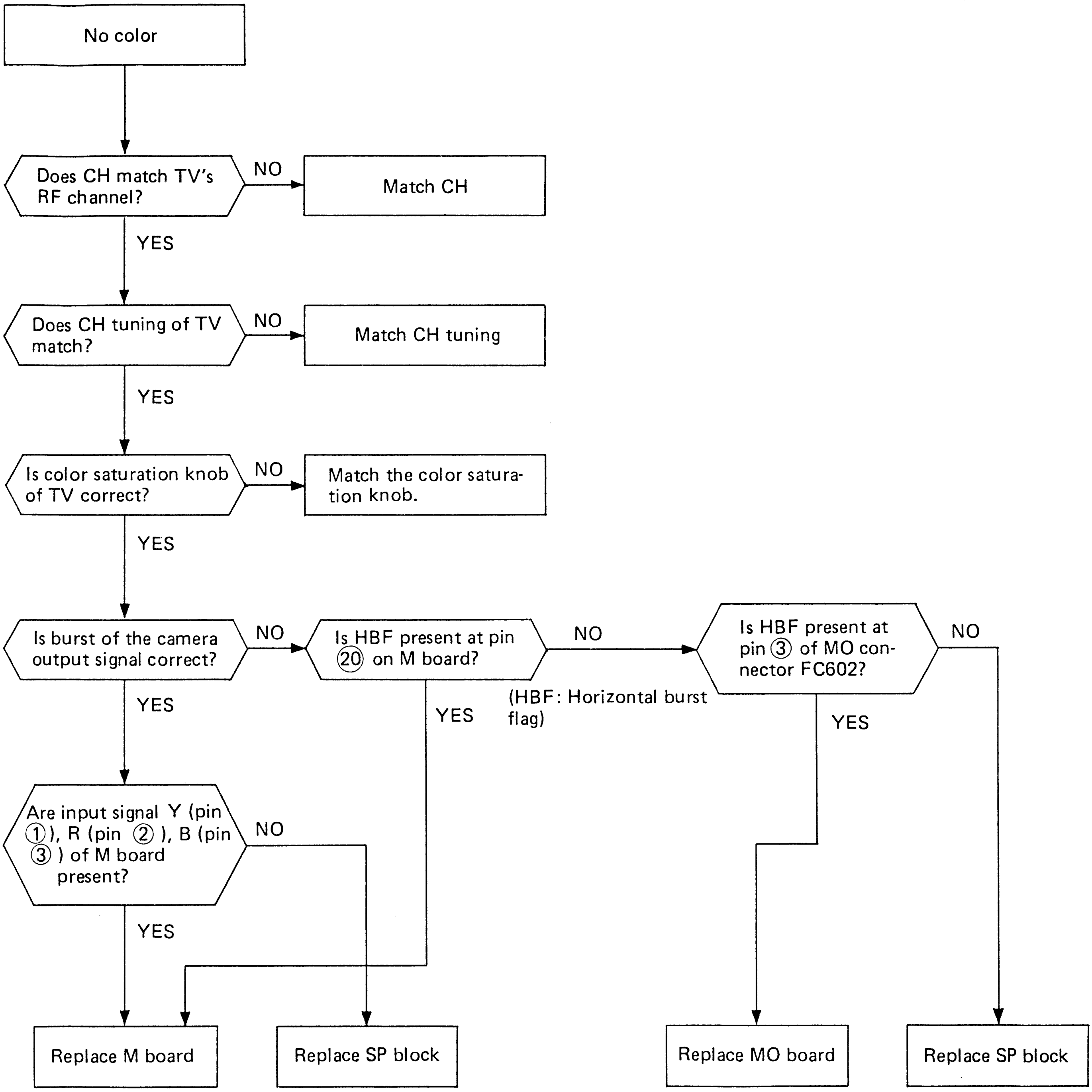
(2) Check the input power voltage.
Check whether the voltage supplied to the camera is normal or not.

1. Picture does not appear

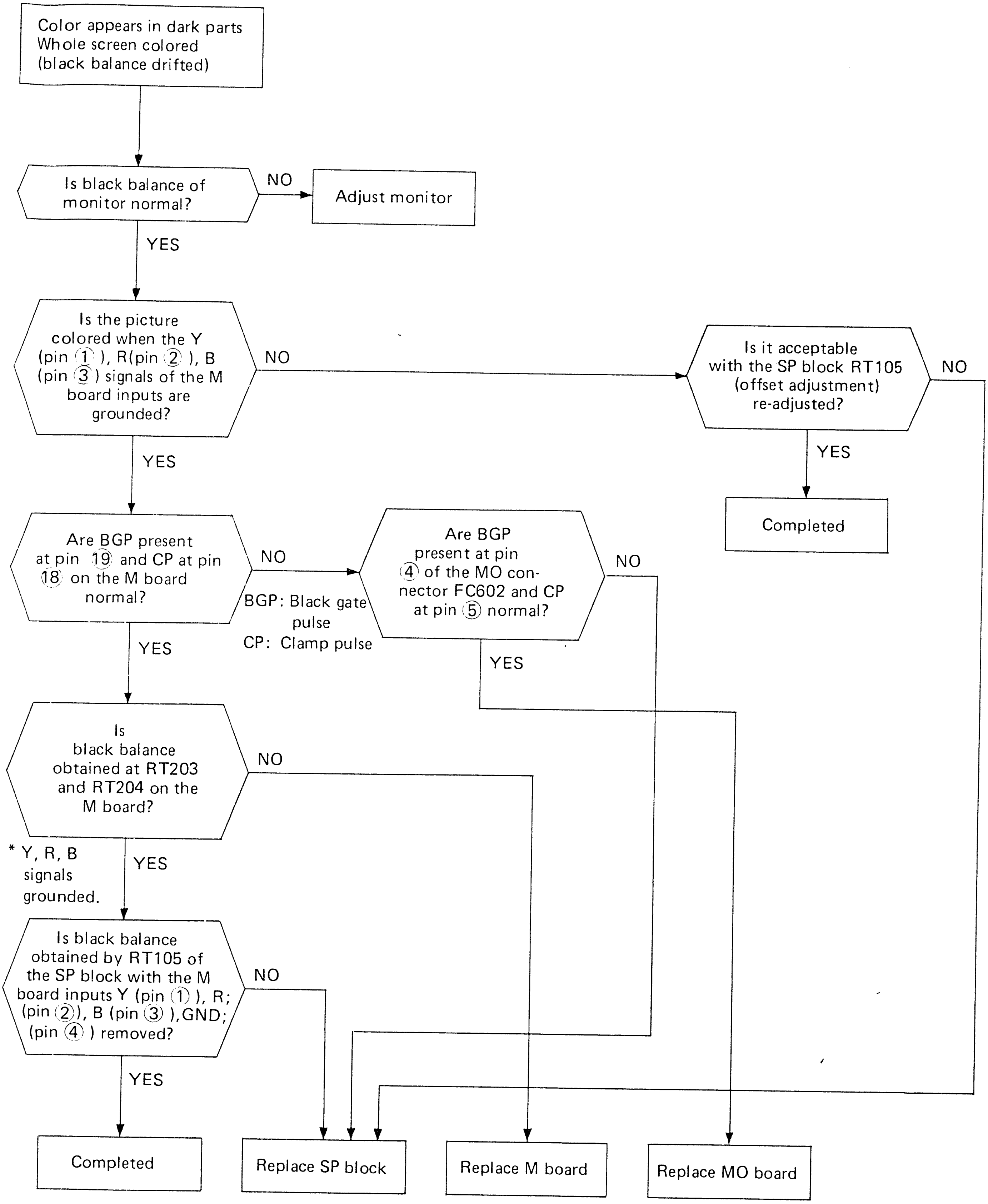


Picture does not appear
Is the lens cap removed?
NO
Remove the lens cap.
YES
Is the power save switch set to "NORMAL"?
NO
Set it to "NORMAL".
YES
Is random noise seen in the picture?
NO
Is the sync signal correctly applied to the camera output signal?
NO
Is 9V output to IC208 pin ② ?
NO
Is the fuse blown?
NO
YES
YES
YES
YES
Is the iris open?
NO
Are CN501 and DR502 disconnected?
NO
YES
YES
Are Y, R, B signals applied properly to T1, T3, T4 on the MO board?
NO
Is the 14MHz signal 3Vp-p or more at CN201 pin ② ?
NO
YES
YES
Replace CN501 and DR502
Replace SP block
Replace I board
Replace M board.
Replace fuse.

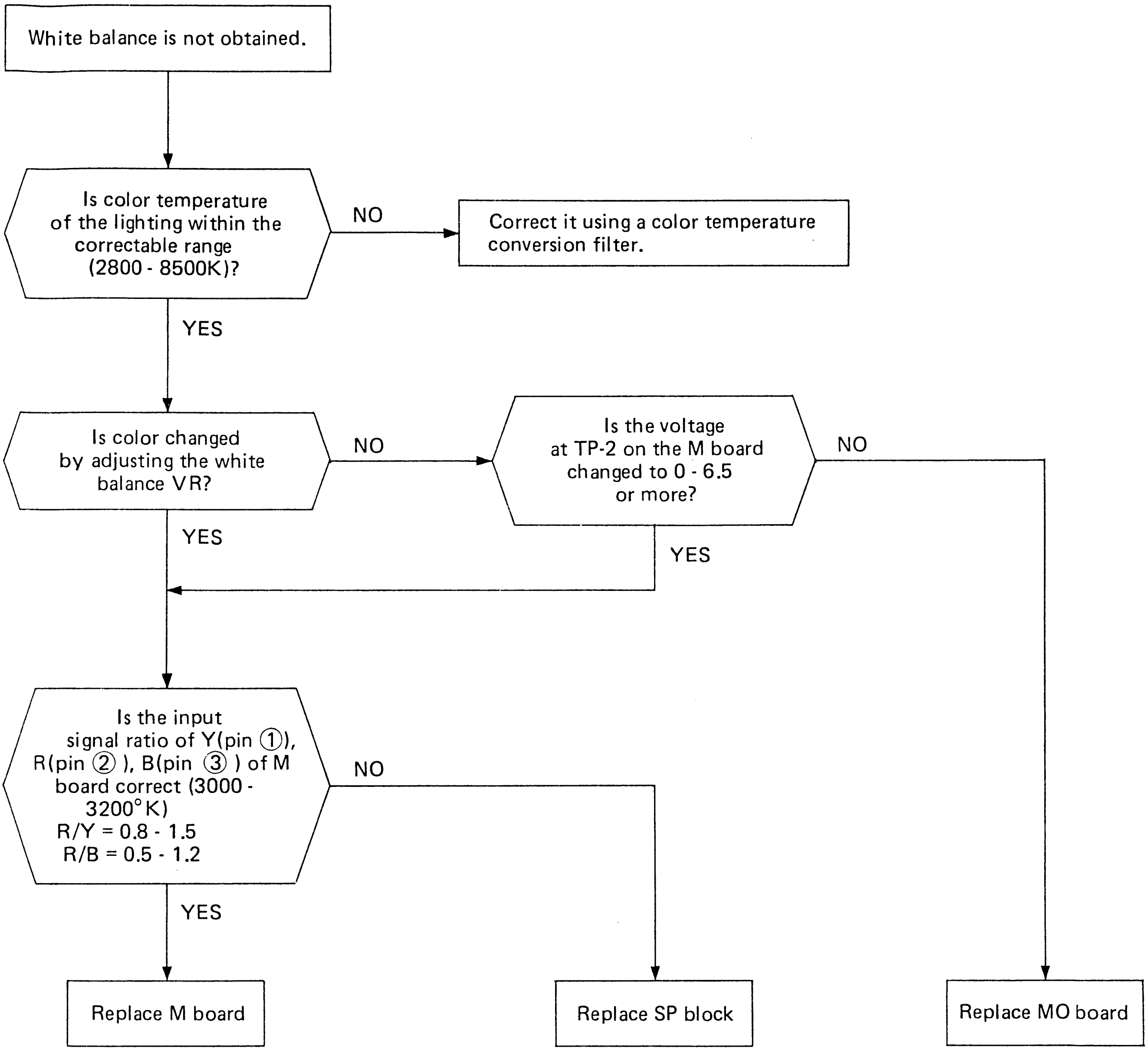
2. No color


No color
Does CH match TV's RF channel?
NO
Match CH
YES
Does CH tuning of TV match?
NO
Match CH tuning
YES
Is color saturation knob of TV correct?
NO
Match the color saturation knob.
YES
Is burst of the camera output signal correct?
NO
Is HBF present at pin ⑳ on M board?
NO
Is HBF present at pin ③ of MO connector FC602?
NO
YES
(HBF: Horizontal burst flag)
YES
YES
Are input signal Y (pin ①), R (pin ②), B (pin ③) of M board present?
NO
YES
Replace M board
Replace SP block
Replace MO board
Replace SP block

3. Color appears in dark parts. Whole screen colored (black balance drifted)


Color appears in dark parts
Whole screen colored
(black balance drifted)
Is black balance of monitor normal?
NO
Adjust monitor
YES
Is the picture colored when the Y (pin ①), R(pin ②), B (pin ③) signals of the M board inputs are grounded?
NO
Is it acceptable with the SP block RT105 (offset adjustment) re-adjusted?
NO
YES
Completed
YES
Are BGP present at pin ⑲ and CP at pin ⑱ on the M board normal?
NO
BGP: Black gate pulse
CP: Clamp pulse
Are BGP present at pin ④ of the MO connector FC602 and CP at pin ⑤ normal?
NO
YES
YES
Is black balance obtained at RT203 and RT204 on the M board?
NO
* Y, R, B signals grounded.
YES
Is black balance obtained by RT105 of the SP block with the M board inputs Y (pin ①), R; (pin ②), B (pin ③), GND; (pin ④) removed?
NO
YES
Completed
Replace SP block
Replace M board
Replace MO board

4. White balance is not obtained (Not obtained by adjustment while monitoring using EE system)


White balance is not obtained.
Is color temperature of the lighting within the correctable range (2800 - 8500K)?
NO
Correct it using a color temperature conversion filter.
YES
Is color changed by adjusting the white balance VR?
NO
Is the voltage at TP-2 on the M board changed to 0 - 6.5 or more?
NO
YES
YES
Is the input signal ratio of Y(pin ①), R(pin ②), B(pin ③) of M board correct (3000 - 3200°K)
R/Y = 0.8 - 1.5
R/B = 0.5 - 1.2
NO
YES
Replace M board
Replace SP block
Replace MO board

ADJUSTMENT

1. Before starting adjustment

Check the following before starting adjustment.

(Note) The circuit board is checked unassembled, but adjust it by the following procedure to check it when it is replaced.

1-1. Connection

Connection between camera and power supply, TV set (monitor), etc.

1-2. Measuring instruments, tools, etc. used for adjustment

Measuring instruments

Oscilloscope, digital voltmeter

Tools, etc.

Adjustment screwdriver, soldering iron, color viewer (3200 °K), gray scale chart (11 steps), colorbar chart, tripod, TV set (monitor).

1-3. Preparation

Set the distance between the lens surface of the camera and the color viewer to approx. 2 m.

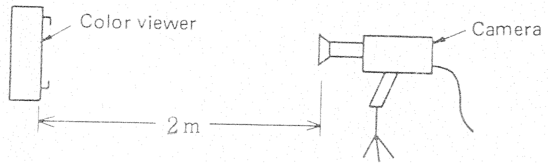


Fig. 13

Position of camera operation switches

Power save switch: "POWER SAVE" during preparation
"NORMAL" during adjustment

White balance check switch: "OFF" when otherwise not specified

Remove the viewfinder (called EVF hereafter) and the exclusive microphone when adjusting the camera main body.

Perform adjustment with the time axis of the oscilloscope set to H period (20 μs/div. or 10 μs/div.) when otherwise not specified.

Set the time axis to the V period (5 ms/div.) or to the H period as specified in the text.

2. Adjustment when replacing SP block

1) Mount the lens cap on the lens block.
2) Connect the digital voltmeter to TP-2 on the M board.
3) Adjust the white balance VR at the back of the camera so that the reading of the digital voltmeter is 1.5±0.05V (1.8±0.1V for VK-C1000(C)).
4) Connect the oscilloscope to PG602 pin 10 (camera output signal) on the MO board. (Time axis: H period)
5) Offset adjustment
   Adjust RT105 of the SP block while observing the oscilloscope so that the leakage of the carrier (3.58 MHz) of the camera output signal is minimum.

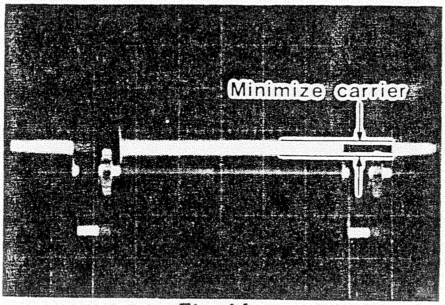


Fig. 14

6) Carrier balance adjustment
   Alernately adjust RT203 and RT204 on the M board as in the offset adjustment so that the leakage of the carrier of the camera output signal is minimum.

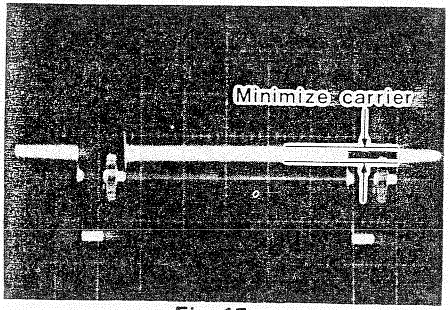


Fig. 15

7) Alternately perform offset adjustment and carrier balance adjustment so that the leakage of the carrier is minimum.
8) Insert the gray scale chart into the color viewer and adjust the focus.
9) Adjust the zoom so that the gray scale chart fills the TV (monitor) screen.
10) White balance adjustment
    Alternately adjust RT102 and RT103 of the SP block so that the leakage of the carrier is minimum for each step of the gray scale.

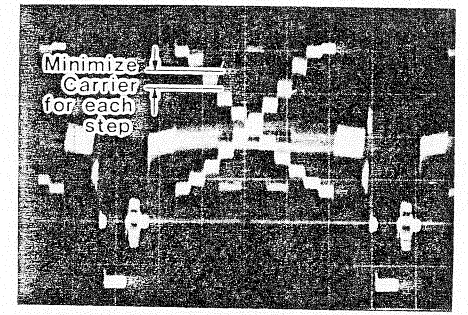


Fig. 16

11) Shoot the dark object with a luminance of approx. 500 lux.

12) 1.8 MHz flicker adjustment
Pan the camera gradually to left and right while watching the TV monitor screen and adjust RT401 and RT402 on the L circuit board to minimize the 1.8 MHz signal seen as vertical stripes on the screen.

13) Shoot the colorbar chart, etc. to check that the picture is normal.

3. Adjustment when replacing M board.

1) Mount the lens cap to the lens block.
2) Connect the digital voltmeter to TP-2 on the M board.
3) Adjust the white balance VR at the back of the camera to set the reading of the digital voltmeter to 1.5 ± 0.1V (1.8 ± 0.1V for VK-C1000 (C)).
4) Connect the oscilloscope to PG602 pin 10 (camera output signal) on the MO board. (Time axis: H period)
5) Carrier balance adjustment
Alternately adjust RT203 and RT204 on the M board while observing the oscilloscope so that the leakage of the carrier (3.58 MHz) of the camera output signal is minimum.

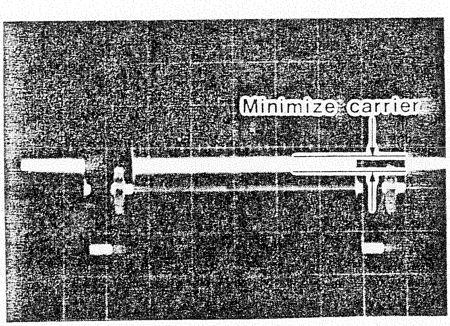


Fig. 17

6) Set-up adjustment
Adjust RT205 on the M board to set the set-up amount of the camera output signal to 70 ±10 mV.

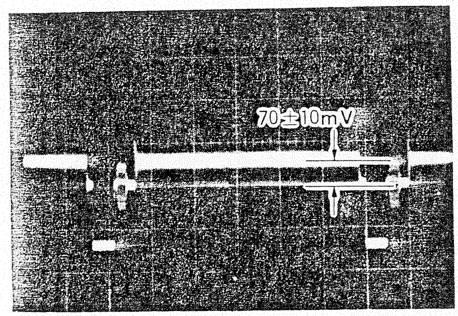


Fig. 18

7) Insert the gray scale chart into the color viewer and adjust the focus.
8) Adjust the zoom so that the gray scale chart fills the TV (monitor) screen.
9) Iris adjustment
Adjust RT502 on the I board so that the camera output signal is 1.04 ± 0.04Vp-p.

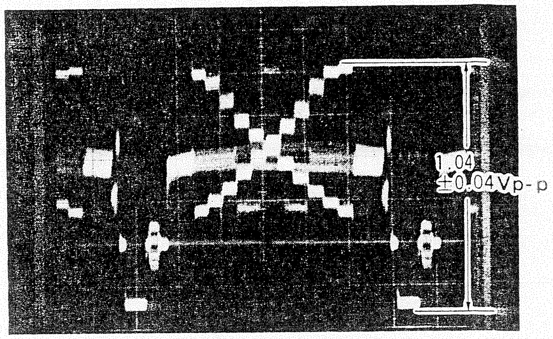


Fig. 19

10) White balance adjustment
Alternately adjust RT102 and RT103 of the SP block so that the leakage of the carrier at each step of the gray scale is minimum.

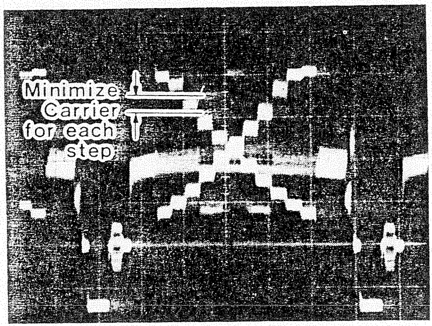


Fig. 20

11) Mount the lens cap to the lens block again.
12) L indicator adjustment
    1. Measure the potential at IC508 pin 6 on the I board using a digital voltmeter.
    2. Adjust RT501 on the I board so that the potential of IC508 pin 5 on the I board is 0.1 - 0.15V higher than that of pin 6 .

Note: When the digital voltmeter is not available, adjust RT501 on the I board so that the L indicator flashes. Turn RT501 20° - 30° in the direction to light the L indicator.

13) Shoot the colorbar, etc. to check that the picture is normal.

4. Adjustment when replacing I board

1) Mount the lens cap on the lens block.
2) Connect the digital voltmeter to, TP-2 on the M board.
3) Adjust the white balance VR at the back of the camera to set the reading of the digital voltmeter to 1.5 ± 0.1V (1.8 ± 0.1V for VK-C1000(C)).
4) Connect the oscilloscope to PG602 pin 10 (camera output signal) on the MO board. (Time axis: H period)
5) Insert the gray scale into the color viewer and adjust the focus.
6) Adjust zoom so that the gray scale chart fills the TV (monitor) screen.

7) Iris adjustment

Adjust RT502 on the I board while observing the camera output signal using an oscilloscope so that the camera output signal is 1.04±0.04Vp-p.

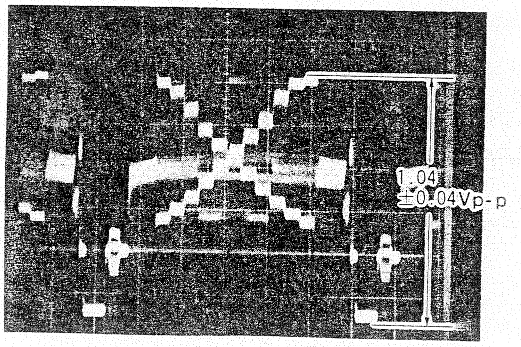


Fig. 21

8) Mount the lens cap on the lens block.

9) L indicator adjustment
   1. Measure the potential at IC508 pin 6 on the I board.
   2. Adjust RT501 on the I board so that the potential of IC508 pin 5 on the I board is 0.1~ 0.5V higher than of pin 6

Note: When the digital voltmeter is not available, adjust RT501 on the I board so that the L indicator flashes. Turn RT501 20°~ 30° in the direction to light the L indicator.

10) Shoot the colorbar, etc. to check that the picture is normal.

5. Adjustment when replacing L board

1) Mount the lens cap to the lens block.
2) Offset adjustment
   Minimize the 1.8 MHz which is seen as a vertical stripe while observing the TV (monitor) picture using RT403 on the I board.
3) Shoot a dark object with a luminance of approx. 500 lux.
4) 1.8 MHz flicker adjustment
   Pan the camera gradually to left and right while watching the TV(monitor) screen and adjust RT401 and RT402 on the L circuit board to minimize the 1.8 MHz signal seen as vertical stripes on the screen.
5) Pan the camera to the left and right to check that the 1.8 MHz flicker is not conspicuous.
6) Insert the colorbar chart into the color viewer, and shoot 4 colors [green (G), magenta (Mg), red (R), blue (B)] of the colorbar to fill the TV (monitor) screen.
7) Adjust RT404 and RT405 on the L board so that the fixed 1.8 MHz component at the red (R) and magenta (Mg) sections is minimum.
8) Perform offset adjustment according to items 1 and 2 again.

6. Adjustment/measurement locations on each board

(1) SP block

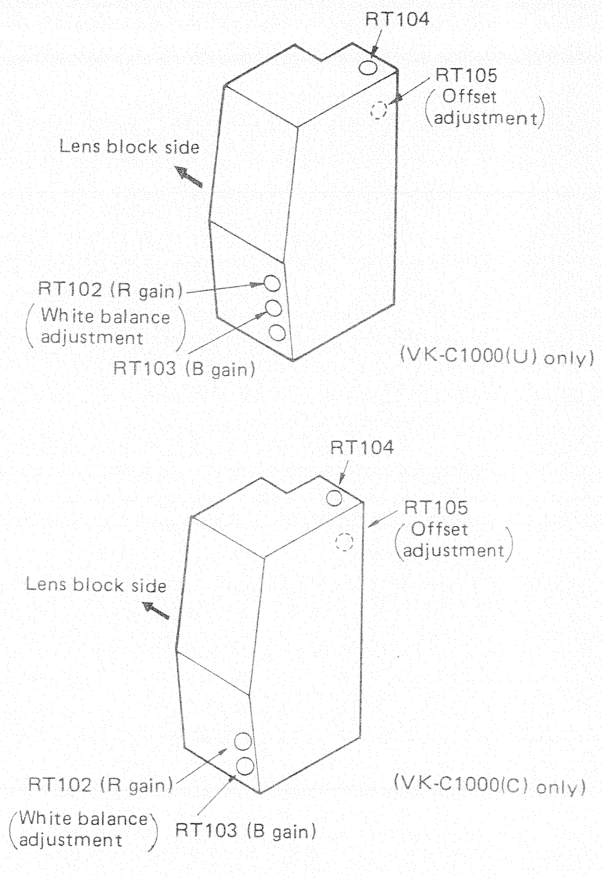

RT104
RT105
(Offset adjustment)
Lens block side
RT102 (R gain)
(White balance adjustment)
RT103 (B gain)
(VK-C1000(U) only)
RT104
RT105
(Offset adjustment)
Lens block side
RT102 (R gain)
(White balance adjustment)
RT103 (B gain)
(VK-C1000(C) only)

Fig. 24

(2) M circuit board (Parts side)

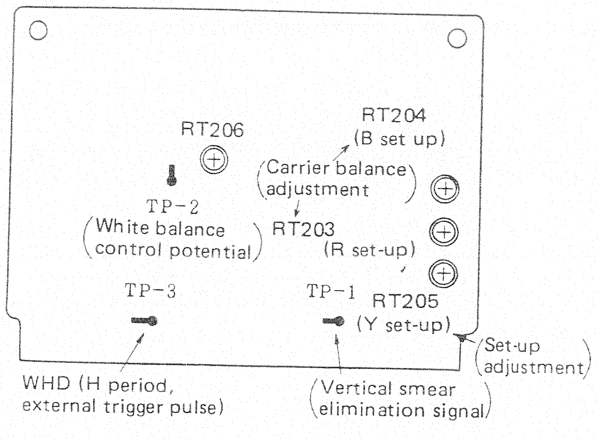

RT206
RT204
(B set up)
(Carrier balance adjustment)
TP-2
(White balance control potential)
RT203
(R set-up)
TP-3
TP-1
RT205
(Y set-up)
(Set-up adjustment)
WHD (H period, external trigger pulse)
(Vertical smear elimination signal)

Fig. 25

(3) I circuit board (parts side)

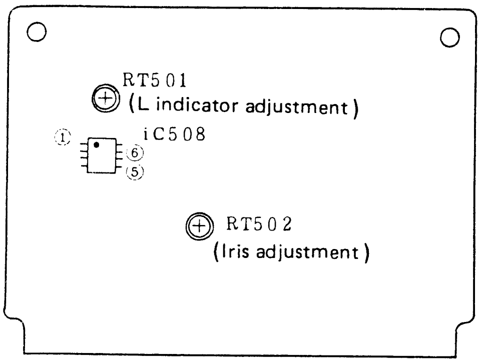
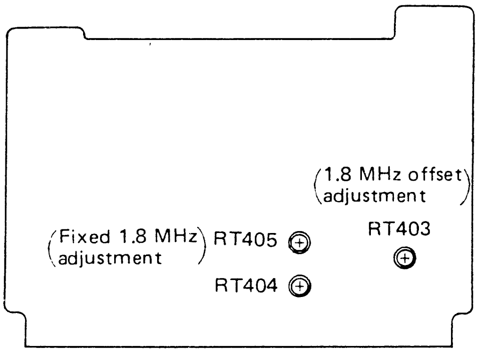

RT501
(L indicator adjustment)
①
iC508
⑥
⑤
RT502
(Iris adjustment)

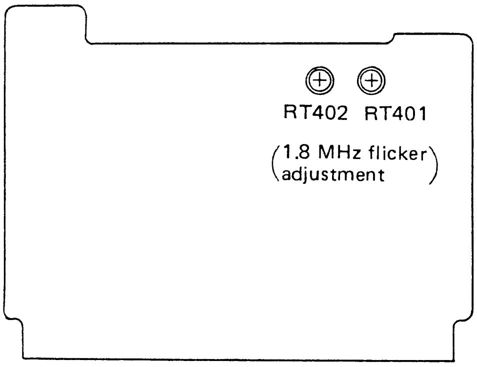
Fig. 26

(4) L circuit board


(1.8 MHz offset adjustment)
RT403
(Fixed 1.8 MHz adjustment)
RT405
RT404

(To be adjusted from M board side)

Fig. 27


RT402
RT401
(1.8 MHz flicker adjustment)

(To be adjusted from I board side)

Fig. 28

(5) MO circuit board

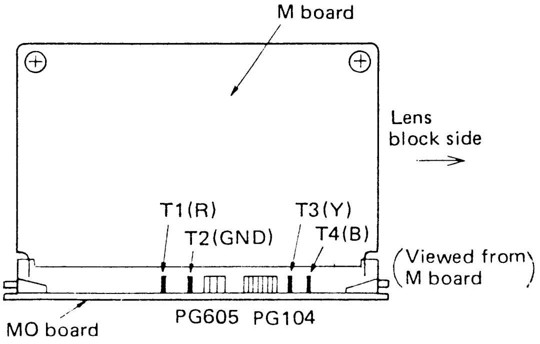

M board
Lens block side
T1(R)
T2(GND)
T3(Y)
T4(B)
(Viewed from M board)
MO board
PG605
PG104

Fig. 29

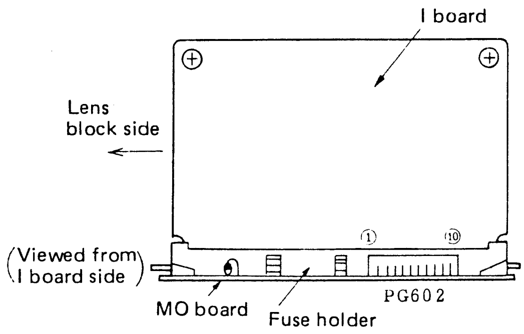

I board
Lens block side
(Viewed from I board side)
①
⑩
MO board
Fuse holder
PG602

Fig. 30

7. Electronic viewfinder (EVF) adjustment

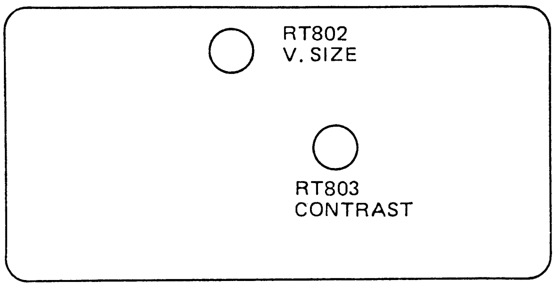

RT802
V. SIZE
RT803
CONTRAST

Fig. 31 E1 board (parts side)

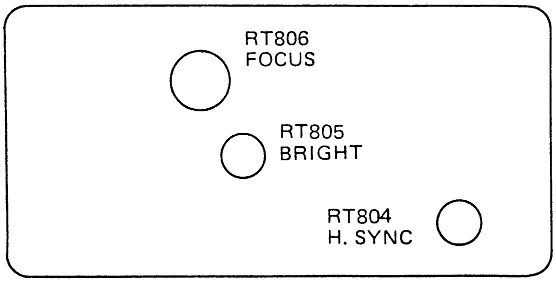
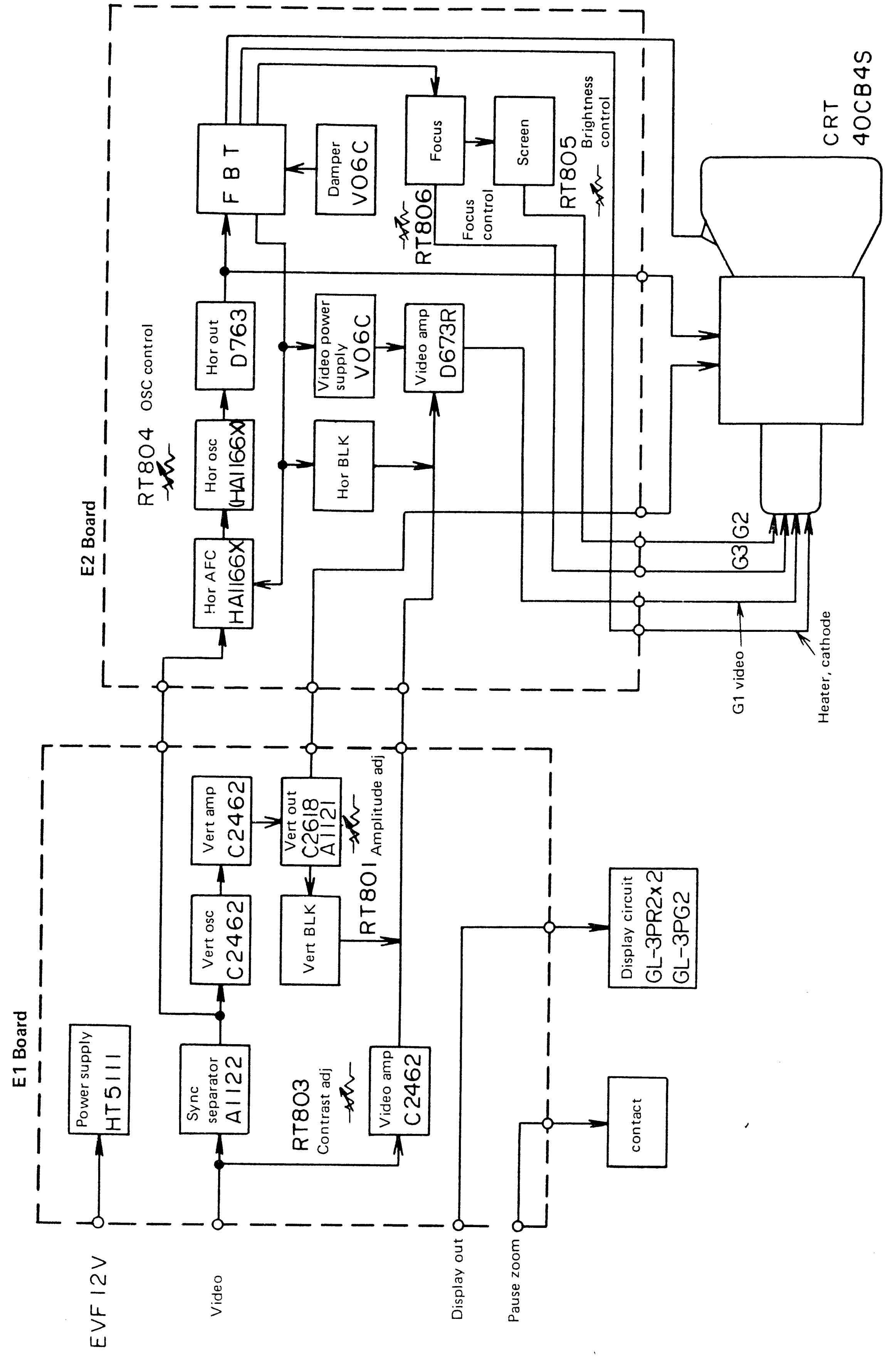

RT806
FOCUS
RT805
BRIGHT
RT804
H. SYNC

Fig. 32 E2 board (parts side)

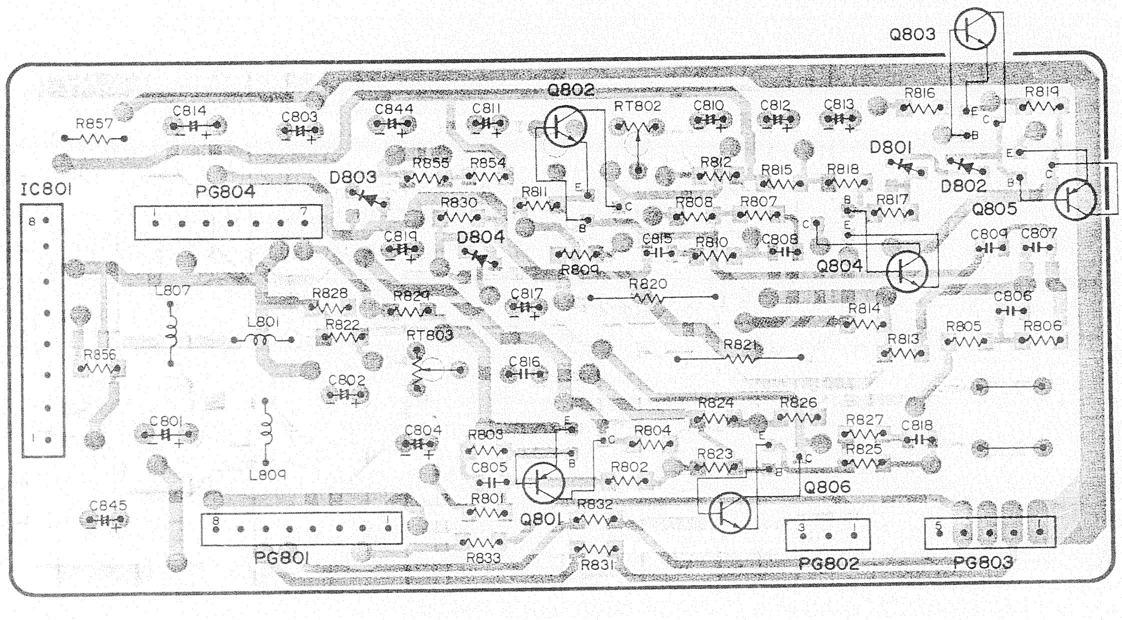
Perform adjustment while observing the viewfinder.

1. Vertical size adjustment
   Adjust vertical size using RT802 (V. SIZE)
2. Contrast adjustment
   Adjust light and shade using RT803 (CONTRAST) so that the picture is easy to see.
3. Horizontal synchronization adjustment
   Adjust horizontal synchronization using RT804 (H. SYNC).
4. Brightness adjustment
   Adjust bright and dark of the picture using RT805 (BRIGHT) so that the picture is easy to see.
5. Focus adjustment
   Adjust RT806 (FOCUS) so that the picture is clear and sharp.
6. Centering adjustment
   Match the raster position using the centering magnets provided with the deflection yoke.

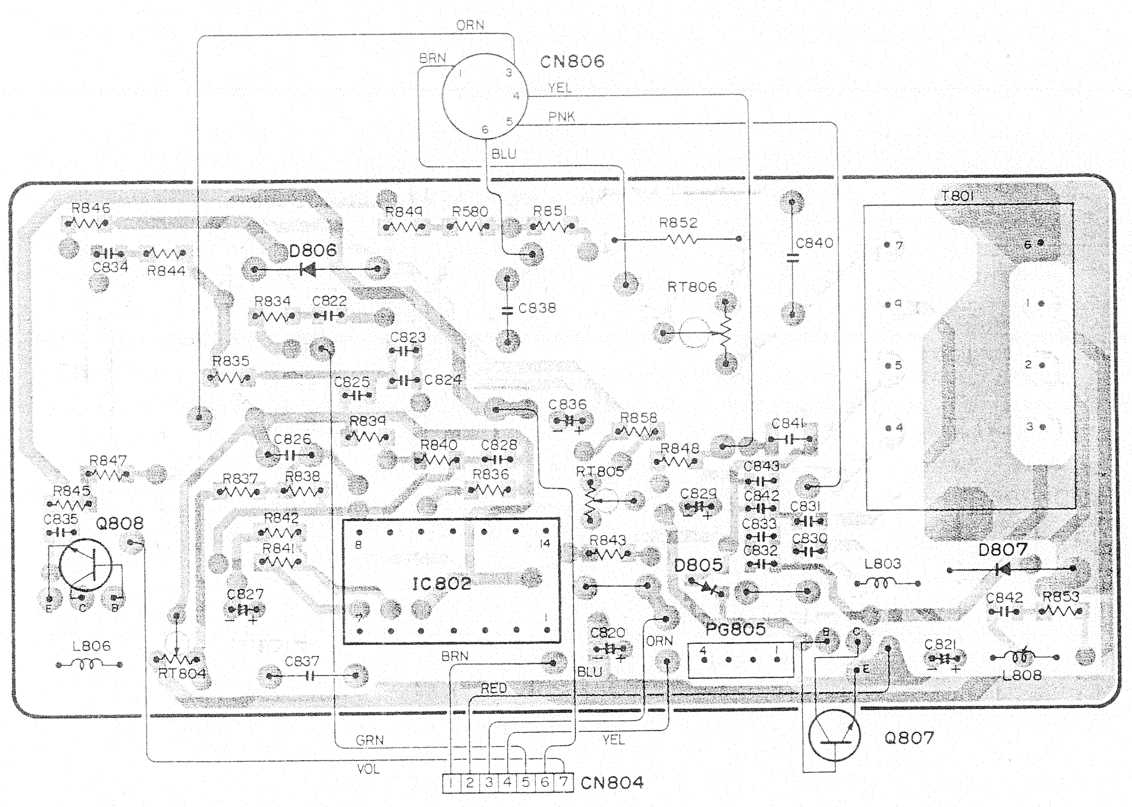
ELECTRONIC VIEWFINDER BLOCK DIAGRAM


E1 Board
E2 Board
Power supply HT5111
Sync separator A1122
Vert osc C2462
Vert amp C2462
Vert out C2618 A1121
Vert BLK
RT801 Amplitude adj
RT803 Contrast adj
Video amp C2462
Display circuit GL-3PR2x2 GL-3PG2
contact
EVF 12V
Video
Display out
Pause zoom
Hor AFC HA1166X
Hor osc HA1166X
RT804 OSC control
Hor out D763
F B T
Damper V06C
Hor BLK
Video power supply V06C
Video amp D673R
Focus
Screen
RT806 Focus control
RT805 Brightness control
CRT 40CB4S
G3
G2
G1 video
Heater, cathode

ELECTRONIC VIEWFINDER CIRCUIT BOARD DIAGRAM

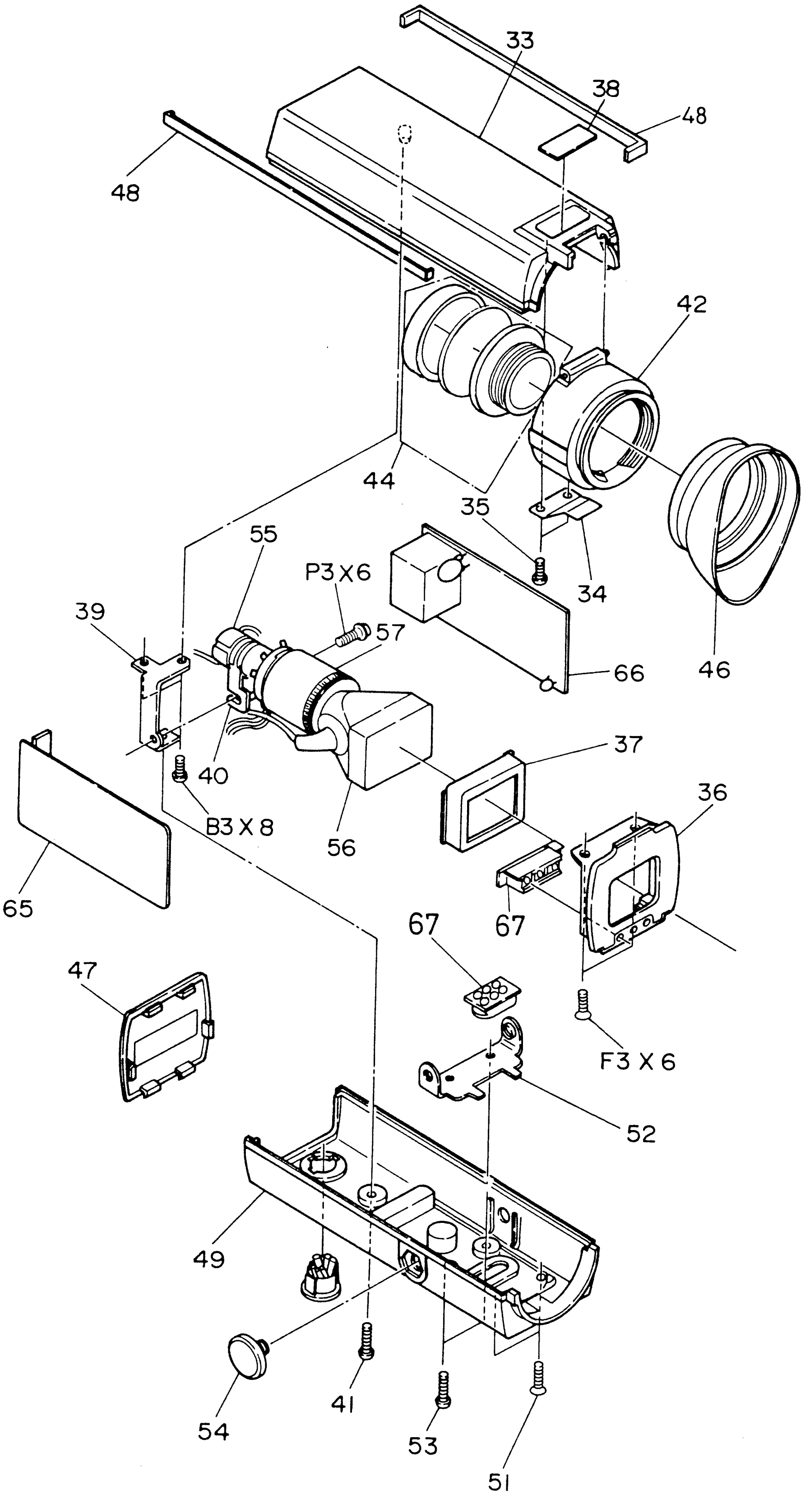

Q803
Q802
RT802
C810
C812
C813
R816
R819
R857
C814
C803
C844
C811
R855
R854
D801
D803
R812
R815
R818
IC801
PG804
R811
R830
R808
R807
R817
D802
Q805
C819
D804
C815
R810
C808
C809
C807
R809
Q804
L807
R828
R829
C817
R820
C806
L801
R822
RT803
R814
R805
R806
R856
R821
R813
C816
C802
R824
R826
C801
C804
R803
R804
R827
C818
R823
R825
C805
R802
Q806
L809
R801
R832
C845
Q801
PG801
R833
R831
PG802
PG803

E1 Board


ORN
BRN
CN806
YEL
PNK
BLU
R846
R849
R580
R851
R852
T801
C834
R844
D806
C840
R834
C822
C838
RT806
C823
R835
C825
C824
C836
R858
C841
C826
R839
R847
R840
C828
R848
R837
R838
R836
RT805
C843
R845
C829
C842
C831
C835
Q808
R842
C833
C830
R841
C832
R843
D805
L803
D807
IC802
C827
C842
R853
C820
PG805
L806
RT804
C837
BRN
ORN
C821
BLU
L808
RED
Q807
GRN
YEL
VOL
CN804

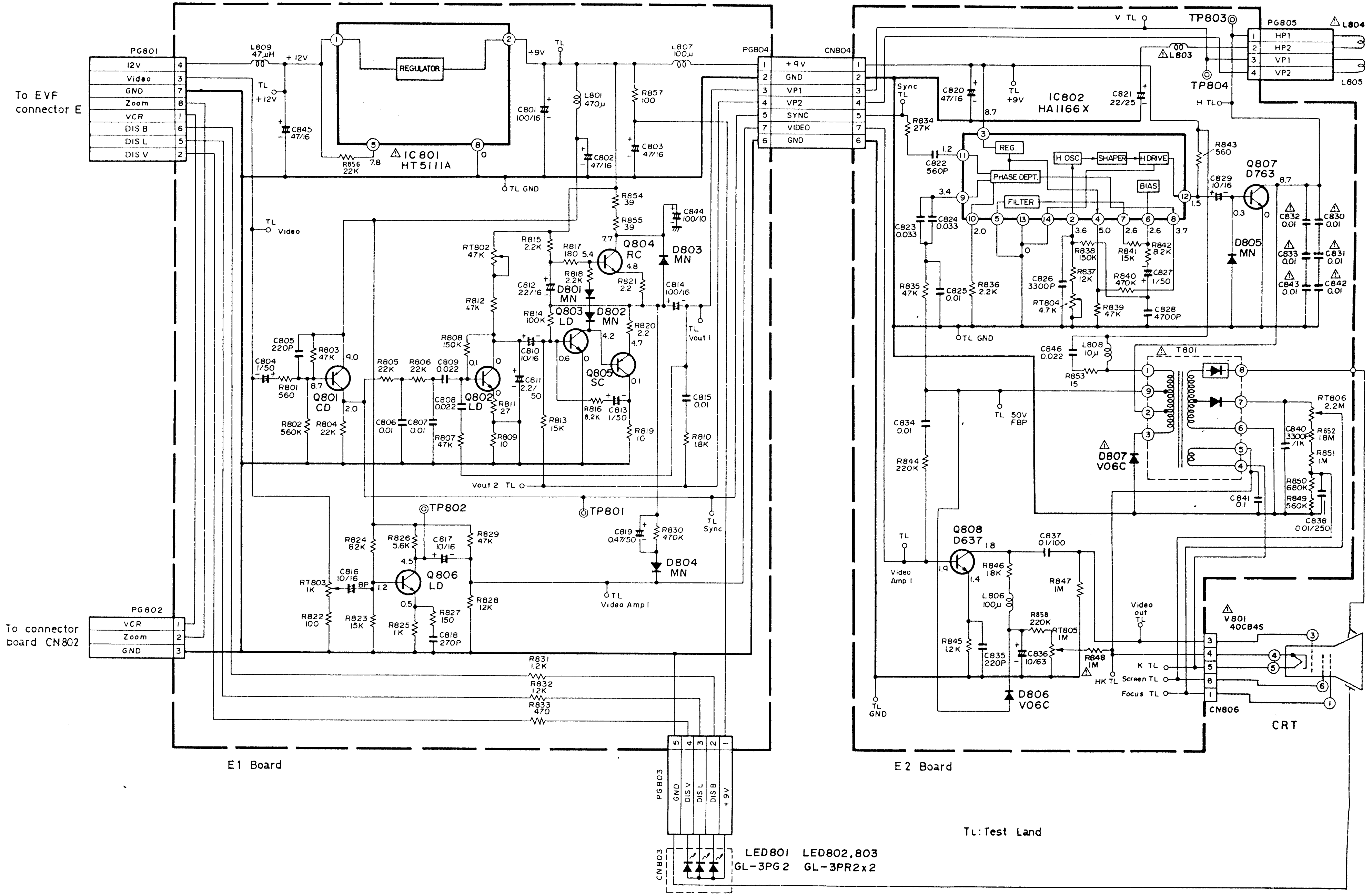
E2 Board

ELECTRONIC VIEWFINDER EXPLODED VIEW

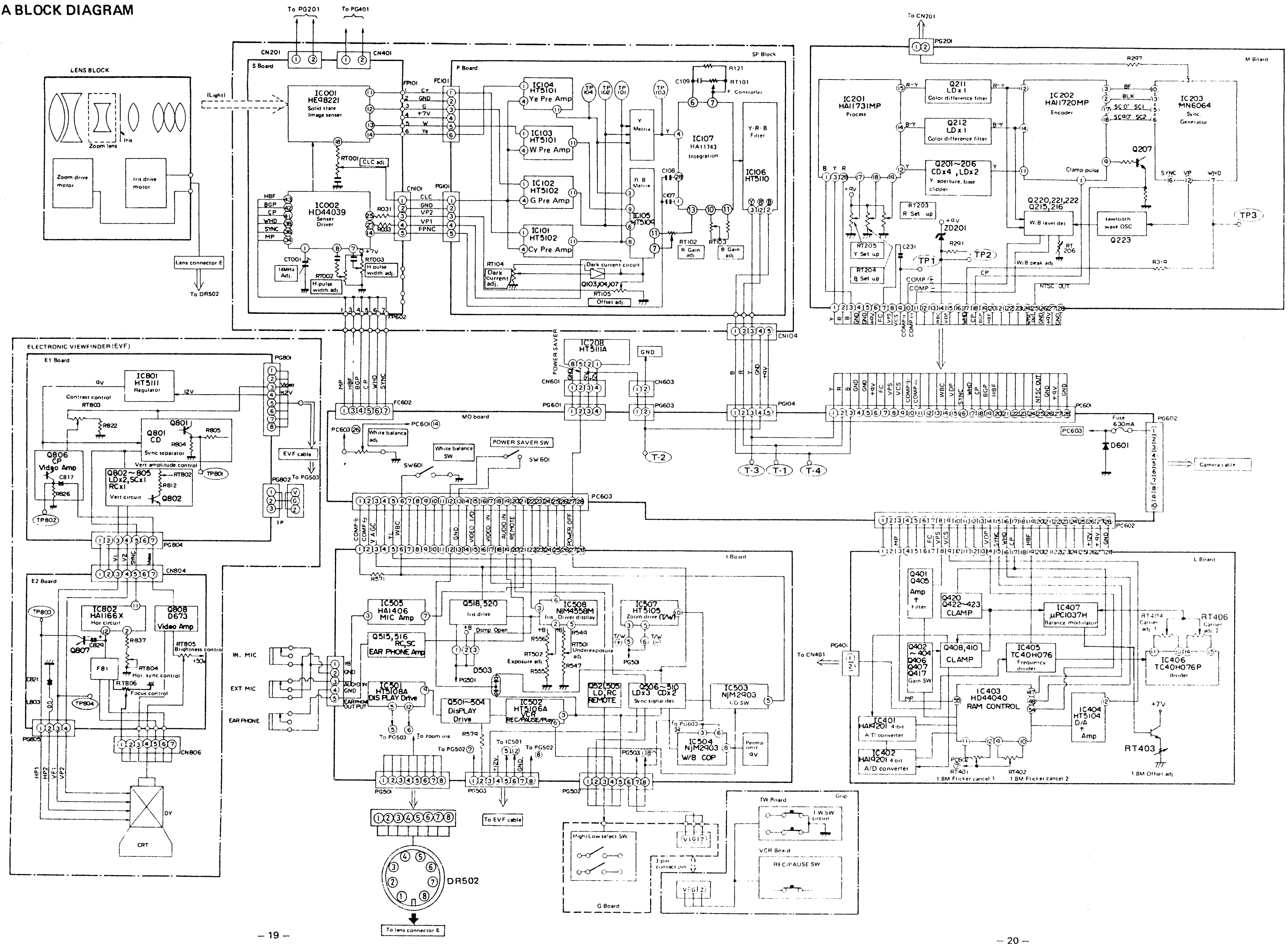


33
38
48
48
42
44
35
35
34
46
66
55
P3 X 6
57
39
40
B3 X 8
56
37
36
65
67
67
47
F3 X 6
52
49
54
41
53
51

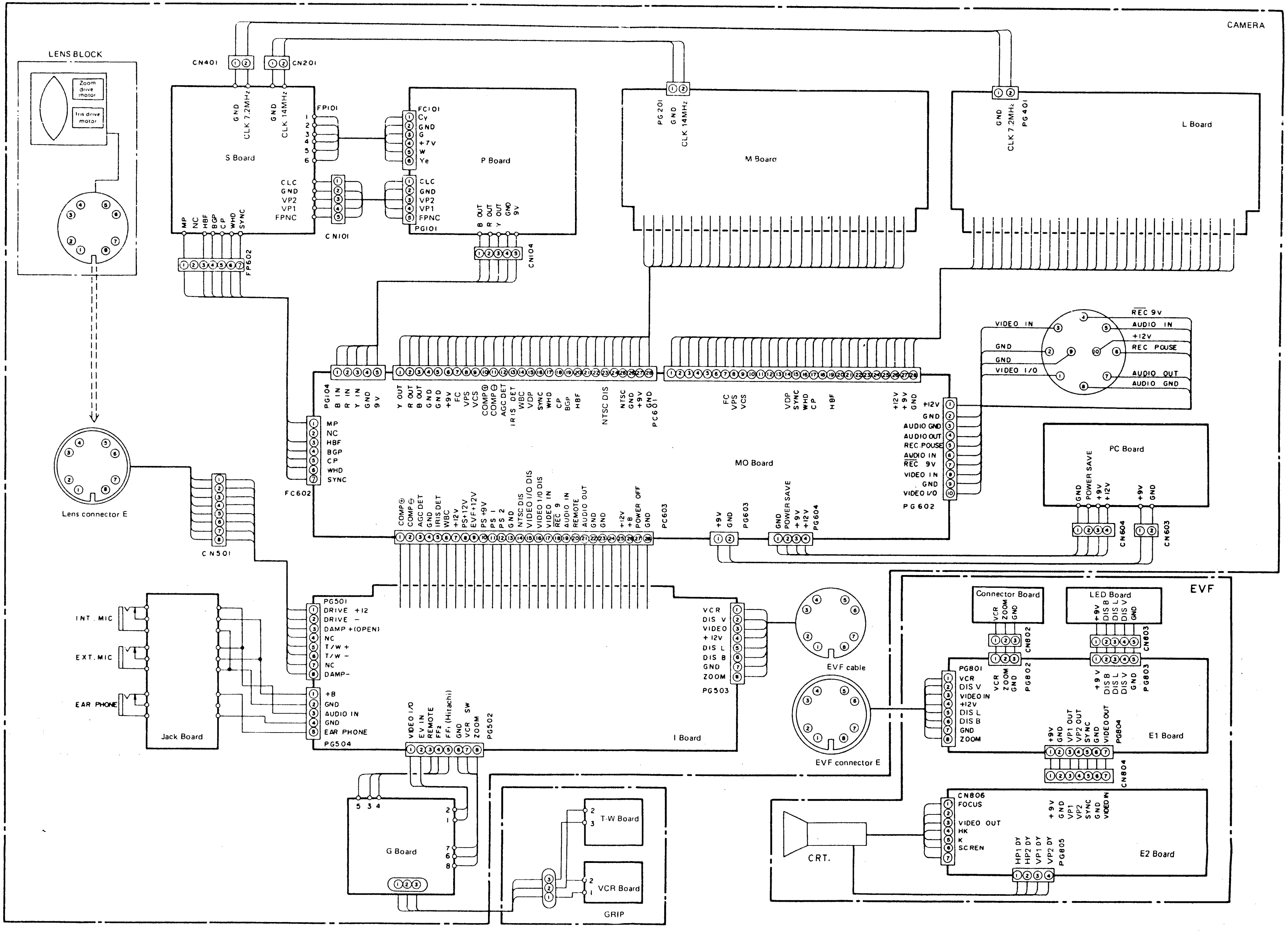
ELECTRONIC VIEWFINDER SCHEMATIC DIAGRAM


To EVF connector E
PG801
12V 4
Video 3
GND 7
Zoom 8
VCR 1
DIS B 6
DIS L 5
DIS V 2
To connector board CN802
PG802
VCR 1
Zoom 2
GND 3
L809 47μH
+12V
TL +12V
C845 47/16
IC801 HT5111A
REGULATOR
R856 22K
7.8
TL GND
+9V
TL
C801 100/16
L801 470μ
C802 47/16
L807 100μ
R857 100
C803 47/16
TL Video
R854 39
R855 39
C844 100/10
Q804 RC
D803 MN
RT802 47K
R815 2.2K
R817 180
R818 2.2K
R821 2.2
C812 22/16
D801 MN
R812 47K
R814 100K
Q803 LD
D802 MN
R820 2.2
C814 100/16
TL Vout 1
C805 220P
R803 47K
C804 1/50
R801 560
Q801 CD
R802 560K
R804 22K
R805 22K
R806 22K
C809 0.022
R808 150K
C810 10/16
C811 2.2/50
Q802 LD
R811 27
R809 10
C806 0.01
C807 0.01
C808 0.022
R807 47K
R813 15K
Q805 SC
R816 8.2K
C813 1/50
R819 10
C815 0.01
R810 1.8K
Vout 2 TL
TP802
TP801
TL Sync
C819 0.47/50
R830 470K
D804 MN
R824 82K
R826 5.6K
C817 10/16
R829 47K
C816 10/16 BP
RT803 1K
Q806 LD
R827 150
R828 12K
TL Video Amp 1
R822 100
R823 15K
R825 1K
C818 270P
R831 1.2K
R832 1.2K
R833 470
E1 Board
PG803
GND 5
DIS V 4
DIS L 3
DIS B 2
+9V 1
CN803
LED801 GL-3PG2
LED802,803 GL-3PR2x2
PG804
CN804
+9V 1
GND 2
VP1 3
VP2 4
SYNC 5
VIDEO 7
GND 6
Sync TL
R834 27K
C820 47/16
TL +9V
IC802 HA1166X
C821 22/25
V TL
TP803
TP804
H TL
L803
PG805
HP1 1
HP2 2
VP1 3
VP2 4
L804
L805
C822 560P
REG.
H OSC
SHAPER
H DRIVE
PHASE DEPT.
BIAS
FILTER
R843 560
C829 10/16
Q807 D763
C823 0.033
C824 0.033
R835 47K
C825 0.01
R836 2.2K
C826 3300P
R838 150K
R837 12K
RT804 4.7K
R841 15K
R842 8.2K
C827 1/50
R840 470K
R839 47K
C828 4700P
D805 MN
C832 0.01
C830 0.01
C833 0.01
C831 0.01
C843 0.01
C842 0.01
TL GND
C846 0.022
L808 10μ
R853 15
T801
TL 50V FBP
D807 V06C
RT806 2.2M
C840 3300P/1K
R852 18M
R851 1M
R850 680K
R849 560K
C841 0.1
C838 0.01/250
C834 0.01
R844 220K
TL
Video Amp 1
Q808 D637
C837 0.1/100
R846 18K
R847 1M
L806 100μ
R858 220K
RT805 1M
R845 1.2K
C835 220P
C836 10/63
D806 V06C
R848 1M
Video out TL
K TL
HK TL
Screen TL
Focus TL
V801 40CB4S
CN806
CRT
TL GND
E2 Board
TL: Test Land

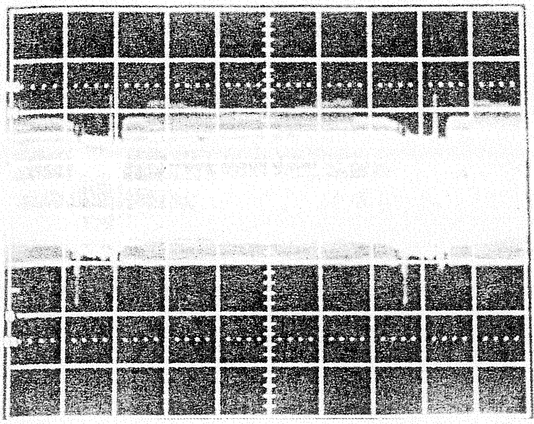
CAMERA BLOCK DIAGRAM


LENS BLOCK
Zoom lens
Iris
Zoom drive motor
Iris drive motor
Lens connector E
To DR502
(Light)
SP Block
S Board
P Board
CN201
CN401
To PQ201
To PG401
IC001 HE98221 Solid state Image sensor
IC002 HD44039 Sensor Driver
HBF
BGP
CP
WHD
SYNC
MP
RT001 CLC adj.
CT001 14MHz Adj.
RT002 H pulse width adj.
RT003 H pulse width adj.
CN101
FP101
FC101
PG101
FP602
CY
GND
G
+7V
W
Ye
CLC
VP2
VP1
FPNC
IC104 HT5101 Ye Pre Amp
IC103 HT5101 W Pre Amp
IC102 HT5102 G Pre Amp
IC101 HT5102 Cy Pre Amp
Y Matrix
R.B Matrix
IC105 HT5109
IC107 HA11743 Integration
IC106 HT5110
Y-R-B Filter
RT121
RT101 F. Controller
RT102 R Gain adj.
RT103 B Gain adj.
RT104 Dark current adj.
Dark current circuit
Q103,104,107
RT105 Offset adj.
TP104
TP102
TP101
TP103
CN104
ELECTRONIC VIEWFINDER (EVF)
E1 Board
IC801 HT5111 Regulator
9V
12V
Contrast control RT803
Q801 CD Sync separator
Vert amplitude control
Q806 CP Video Amp
Q802~805 LDx2, SCx1 RCx1 Vert circuit
Q802
TP801
TP802
PG801
PG802 To PG503
EVF cable
3P
PG804
CN804
V1
V2
SYNC
Video
E2 Board
IC802 HA1166X Hor circuit
Q808 D673 Video Amp
RT805 Brightness control
Q807
FBT
RT806 Focus control
RT804 Hor. sync control
TP803
TP804
PG805
CN806
HP1
HP2
VP1
VP2
DY
CRT
IC208 HT5111A
POWER SAVER
CN601
PG601
CN603
PG603
GND
FC602
MP
HBF
BGP
CP
WHD
SYNC
MO board
PC603
PC601
White balance adj.
White balance SW
SW601
POWER SAVER SW
T-1
T-2
T-3
T-4
PG104
COMP⊕
COMP⊖
V AGC
YL
WBC
VIDEO I/O
VIDEO IN
AUDIO IN
REMOTE
POWER OFF
I Board
R571
IC505 HA1406 MIC Amp
Q515, 516 RC, SC EAR PHONE Amp
Q518, 520 Iris drive
Damp Open
D503
IC508 NJM4558M Iris Driver display
RT502 Exposure adj.
RT501 Underexposure adj.
IC507 HT5105 Zoom drive (T/W)
IN. MIC
EXT. MIC
EAR PHONE
IC501 HT5108A DISPLAY Drive
Q501~504 DISPLAY Drive
IC502 HT5106A VCR REC/PAUSE/Play
Q521, 505 LD, RC REMOTE
Q506~510 LDx3 CDx2 Sync signal det.
IC503 NJM2903 I/O SW
IC504 NJM2903 W/B COP
Permanent 9V
To PG503
To zoom iris
To PG502
To IC501
PG501
PG502
PG503
To EVF cable
DR502
To lens connector E
G Board
High/Low select SW
3 pin contact pin
TW Board
T-W SW circuit
VCR Board
REC/PAUSE SW
Grip
M Board
To CN201
PG201
IC201 HA11731MP Process
Q211 LDx1 Color difference filter
Q212 LDx1 Color difference filter
Q201~206 CDx4, LDx2 Y aperture, base clipper
IC202 HA11720MP Encoder
IC203 MN6064 Sync Generator
Q207
Clamp pulse
Q220, 221, 222 Q215, 216 W.B level det.
Sawtooth wave OSC Q223
RT203 R Set up
RT205 Y Set up
RT204 B Set up
ZD201
TP1
TP2
TP3
RT206 W.B peak adj.
NTSC OUT
PC601
Fuse 630mA
D601
PG602
Camera cable
PC602
To CN401
PG401
L Board
Q401 Q405 Amp + Filter
Q420 Q422~423 CLAMP
IC407 μPC1037H Balance modulator
Q402~404 Q406 Q407 Q417 Gain SW
Q408, 410 CLAMP
IC405 TC40H076 Frequency divider
IC406 TC40H076P divider
RT404 Carrier adj. 1
RT406 Carrier adj. 2
IC401 HA19201 4-bit A/D converter
IC402 HA19201 4-bit A/D converter
IC403 HD44040 RAM CONTROL
IC404 HT5104 D/A + Amp
RT401 1.8M Flicker cancel 1
RT402 1.8M Flicker cancel 2
RT403 1.8M Offset adj.
+7V

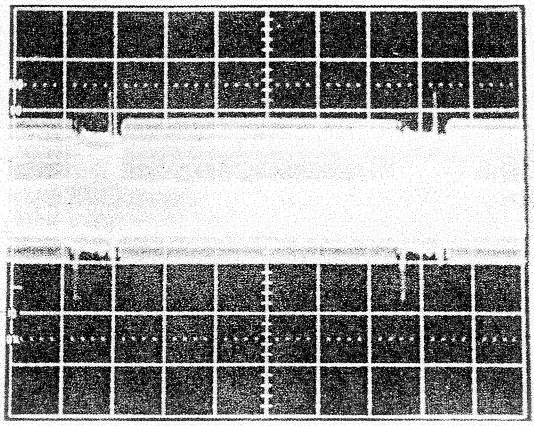
CIRCUIT BOARD CONNECTION DIAGRAM


CAMERA
LENS BLOCK
Zoom drive motor
Iris drive motor
Lens connector E
CN401
CN201
S Board
GND
CLK 7.2MHz
CLK 14MHz
FP101
CLC
GND
VP2
VP1
FPNC
CN101
MP
NC
HBF
BGP
CP
WHD
SYNC
FP602
P Board
FC101
Cv
G
+7V
W
Ye
PG101
B OUT
R OUT
Y OUT
9V
CN104
M Board
PG201
L Board
PG401
PG104
B IN
R IN
Y IN
FC602
MO Board
PG601
NTSC DIS
NTSC
FC
VPS
VCS
VDP
WBC
IRIS DET
AGC DET
COMP⊕
COMP⊖
+9V
+12V
PG602
AUDIO GND
AUDIO OUT
REC POUSE
AUDIO IN
REC 9V
VIDEO IN
VIDEO I/O
PC603
PG603
PG604
POWER SAVE
PS+9V
PS+12V
EVF+12V
PS 1
PS 2
VIDEO I/O DIS
REMOTE
POWER OFF
+B
PC Board
CN604
CN603
CN501
Jack Board
INT. MIC
EXT. MIC
EAR PHONE
I Board
PG501
DRIVE +12
DRIVE −
DAMP +(OPEN)
T/W +
T/W −
DAMP−
PG504
PG502
EV IN
FF2
FF1 (Hitachi)
VCR SW
ZOOM
VIDEO I/O
PG503
VCR
DIS V
VIDEO
DIS L
DIS B
G Board
GRIP
T-W Board
VCR Board
EVF cable
EVF connector E
EVF
Connector Board
LED Board
CN802
CN803
PG801
PG802
PG803
E1 Board
PG804
CN804
VP1 OUT
VP2 OUT
VIDEO OUT
E2 Board
CN806
FOCUS
HK
K
SCREN
HP1 DY
HP2 DY
VP1 DY
VP2 DY
PG805
CRT.

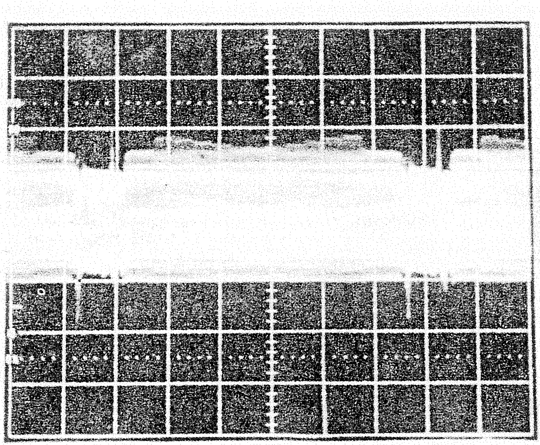
WAVEFORMS (Camera)



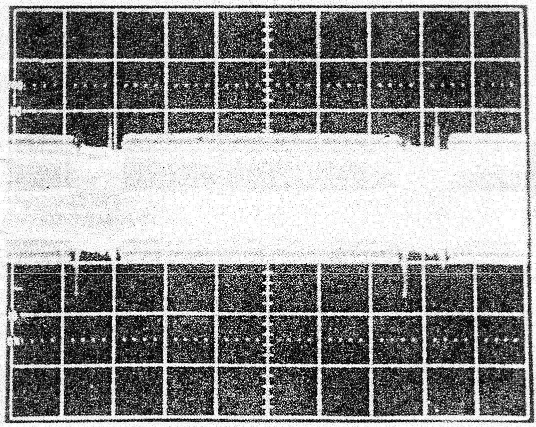
TP101 (Cy) 100 mV/div. 10μsec/div.
When the grey scale chart is shot



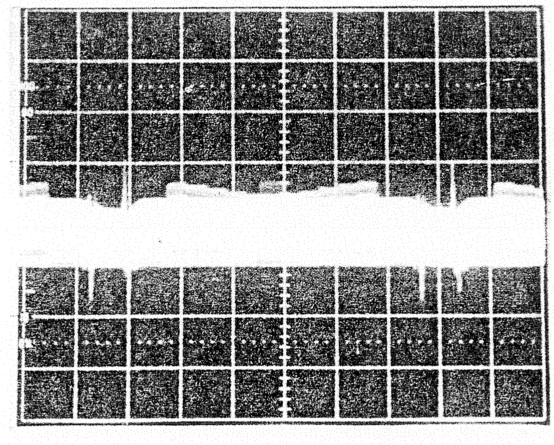
TP101 (Cy) 100mV/div. 10μsec/div.
When the lens cap is in place to shut off the light



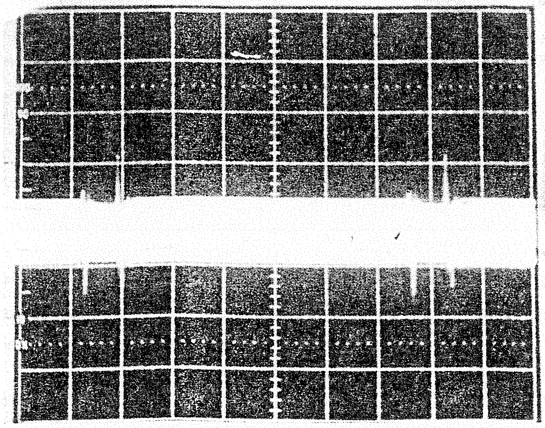
TP102-(G) 100mV/div. 10 μsec/div.
When the grey scale chart is shot



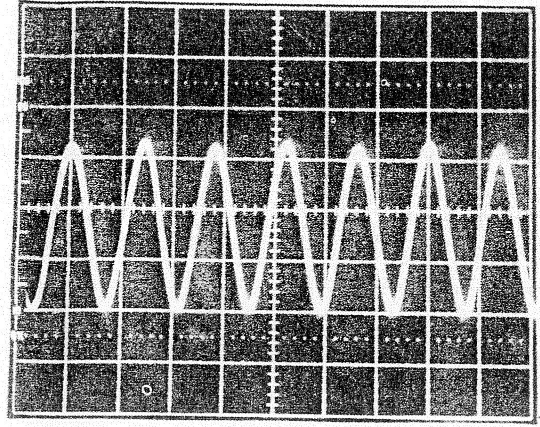
TP102 (G) 100mV/div. 10μsec/div.
When the lens cap is in place to shut off the light



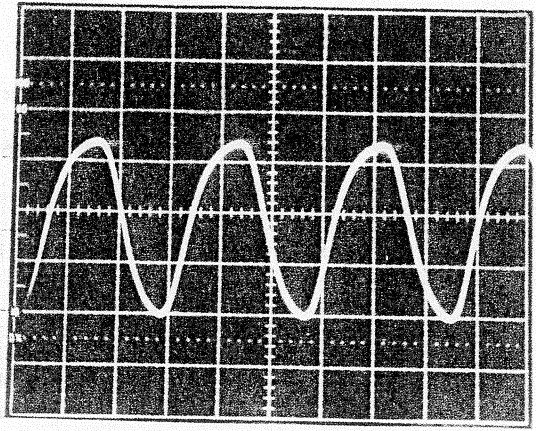
TP103 (Y) 100mV/div. 10μsec/div.
When the grey scale chart is shot



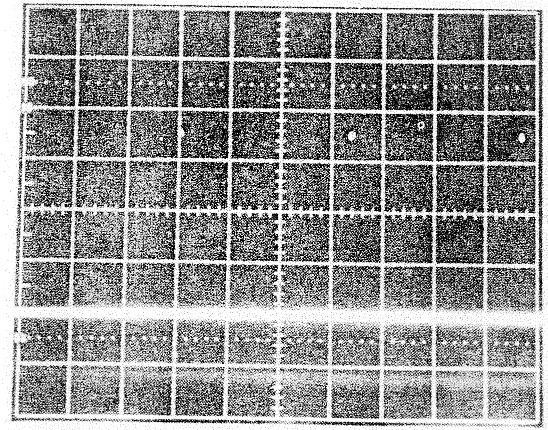
TP103 (Y) 100mV/div. 10μsec/div.
When the lens cap is in place to shut off the light



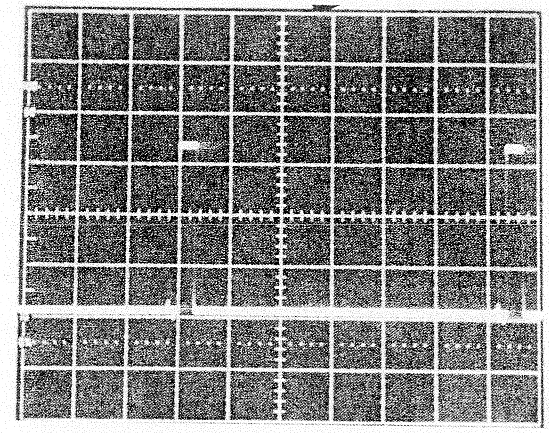
1V/div. CLK 14 MHz
50ms/div. (CN201)



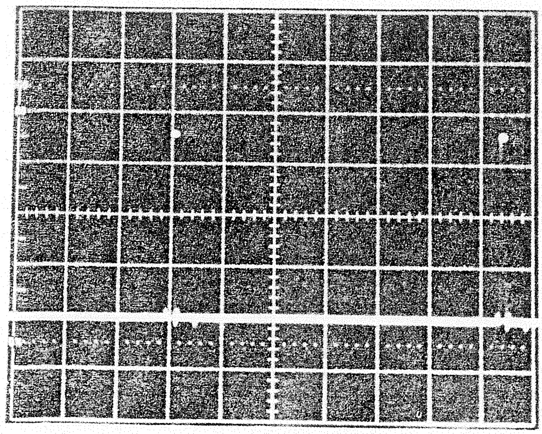
2V/div. CLK 7.2 MHz
50ms/div. (CN401)



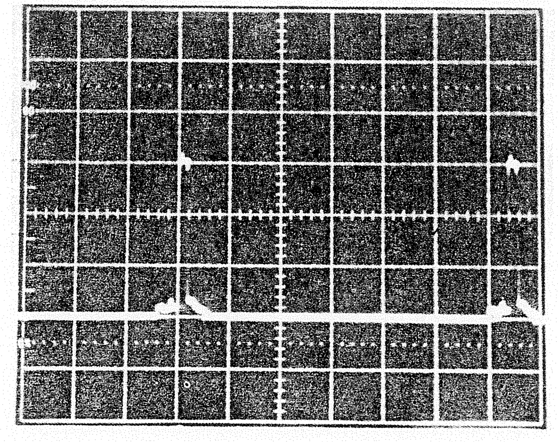
5msec/div. MP
2V/div. (FP602 ① pin)



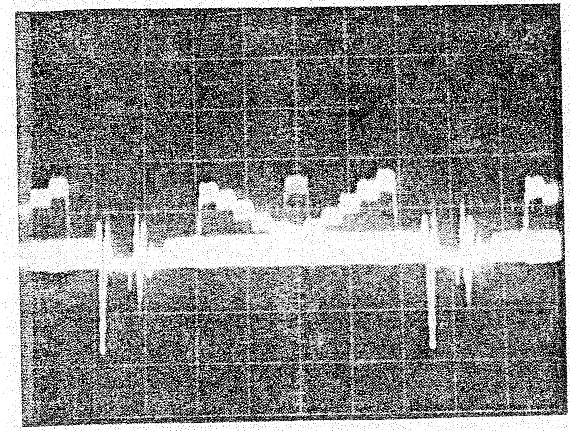
10μS/div. HBF
2V/div. (FP602 ③ pin)



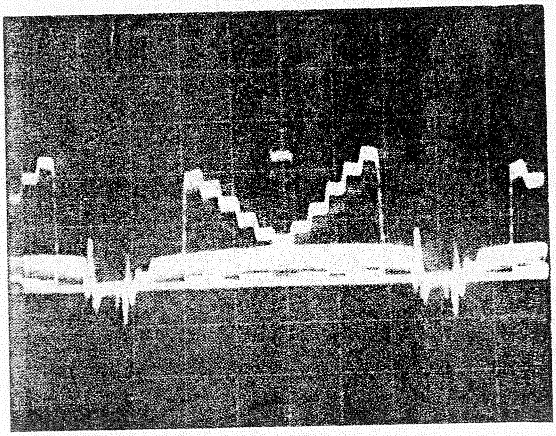
10 μS/div. BGP
2V/div. (FP602 ④ pin)



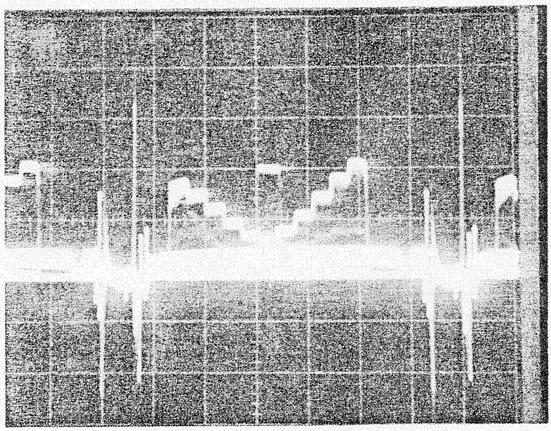
10μS/div. CP
2V/div. (FP602 ⑤ pin)



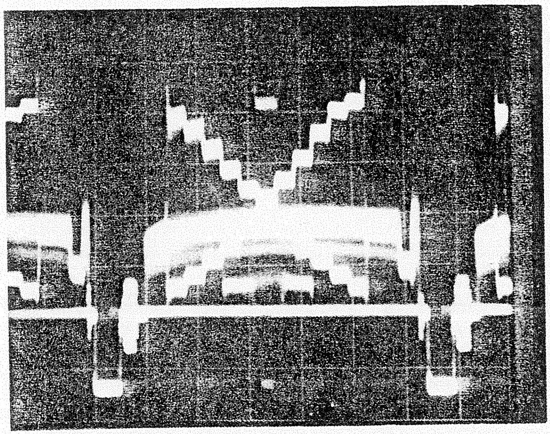
TP1 (R)
200mV/div. 10μsec



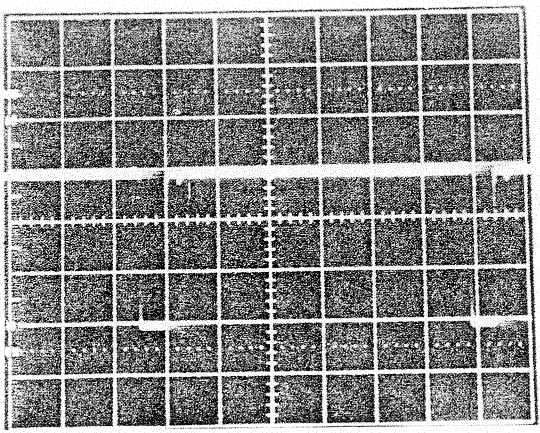
TP4 (B)
200mV/div. 10μsec



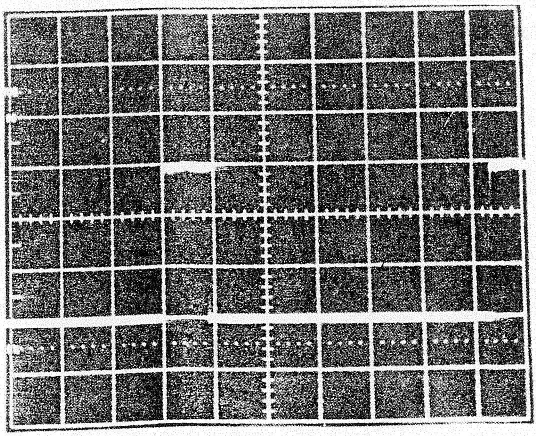
TP3 (Y)
200mV/div. 10μsec



NTSC OUT
200mV/div. 10μsec



SYNC
2V/div. 10μsec/div.
(FP602 ⑦ pin)



WHD
2V/div. 10μsec/div.
(FP602 ⑥ pin)

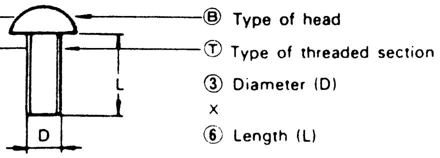
REPLACEMENT PARTS LIST

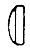
SYMBOL-NO	P-NO	DESCRIPTION
		FOR FINAL ASSEMBLY
1	5899501	CABLE-E.V.F
2	7030183	SIDE CASE-L
3	7030172	SIDE CASE-R
4	7781582	FALT SCREW-3MMDX10MM(BLACK)
5	6107502	COVER-TOP
7	6862832	SWITCH PANEL
8	6291291	KNOB
9	7782131	SPECIAL SCREW
10	6690581	SWITCH COVER
11	7374472	ACCESSORY SHOE
12	6535153	SPRING
13	7547833	SCREW
14	8721108	SCREW (2X8)
15	5421721	MICROPHONE
16	6656111	NAME PLATE (U)
16	6656121	NAME PLATE (C)
17	6977341	HOLDER
18	6973751	FRAME
19	6973761	REAR FRAME
20	6106002	COVER-BOTTOM
21	7373561	BRACKET-P.C.B
23	6690572	JACK METAL
24	6959561	ZOOM LENS
32	5899373	CABLE-CAMERA
33	6105992	CASE-UPPER (EVF)
34	6534821	PLATE SPRING (EVF)
35	8699408	BT BIND HEAD SCREW-3MMDX8MM (BLACK) (EVF)
36	6862983	HOLDER (EVF)
37	6589782	RUBBER (EVF)
38	4610971	LABEL- (EVF)
39	7373471	HOLDER (EVF)
40	6862912	HOLDER (EVF)
41	8744406	BINDING SCREW (EVF)
42	6766082	HOLDER-EYE CAP (EVF)
44	6959602	LENS ASSEMBLY (EVF)
46	6570371	EYE CAP (EVF)
47	6863512	FRONT CAP (EVF)
48	7373502	PLATE (EVF)
49	6863522	CASE-BOTTOM (EVF)
51	7781582	FALT SCREW-3MMDX10MM(BLACK) (EVF)
52	7374041	BRACKET-E.V.F (EVF)
53	8744406	BINDING SCREW (EVF)
54	6295642	KNOB (EVF)
55	5899302	CONNECTOR-E.V.F (EVF)
56	5310571	C.R.T (EVF)
57	5272061	D.Y (EVF)
58	6863691	GRIP
59	6959584	S.P BLOCK (C)
59	7043532	S.P BLOCK (U)
61	5992491	CIRCUIT-M
62	5993511	CIRCUIT-L
63	5992501	CIRCUIT-I
64	5993212	CIRCUIT-MO
⚠ 65	5992521	CIRCUIT-E1 (EVF)
⚠ 66	5992532	CIRCUIT-E2 (EVF)
67	5993152	CIRCUIT-CC
81	6864291	LENS HOOD
82	6864301	LENS CAP
		FOR ACCESSORIES
	5731013	EARPHONE (U)

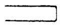
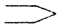
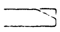
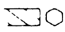
CAMERA EXPLODED VIEW

Screw classification

Example: BT3 × 6

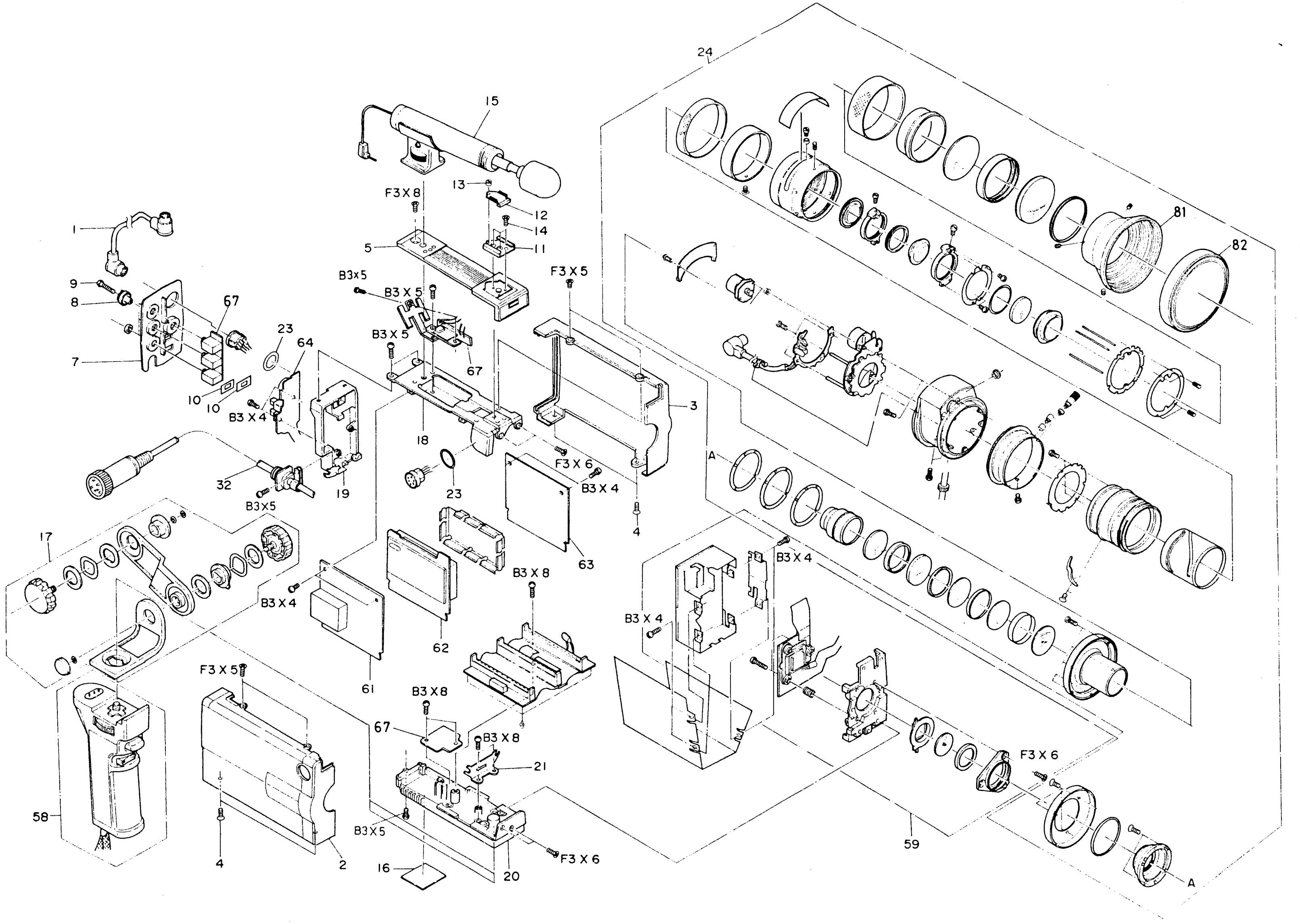


Abbre-viation	Name	Shape
No symbol	Brazier head	
P	Pan head	
B	Binding head	
O	Oval countersunk head	
F	Flat countersunk head	

Abbre-viation	Name	Shape
No symbol	Machine (clamps without tapping)	
t	Tapping (clamps with tapping) Type 1	
T	Tapping (clamps with tapping) Type 2	
f	Forming tight (for metal)	
Note: Since the forming tight screw tightens while self-tapping machine screws can be replaced by tapping screws.		

Washers and Nuts

Abbre-viation	Name	Shape
W SW LW	Washer Spring washer Locking washer	
E	E ring	
N	Nut	
Note: Internal dia. is indicated for nuts and washers.		


F3 X 8
B3x5
B3 X 5
B3 X 5
B3 X 4
F3 X 5
A
B3x5
F3 X 6
B3 X 4
B3 X 4
B3 X 8
B3 X 4
B3 X 4
F3 X 5
B3 X 8
B3 X 8
F3 X 6
B3x5
F3 X 6
A

THEORY

1. Construction of MOS color image sensor

The MOS image sensor has an image size 8.8(H) x 6.5(V) mm matching the 2/3 optical system; the chip size is 10(H) x 8.5(V)mm and number of picture elements is 485(V) x 384(H), totalling 190,000.

This unit employs picture elements (photodiodes) with the npn triple-layer construction, so sensitivity in the infrared area is low, and balanced spectral sensitivity characteristics can be obtained. In addition, blooming suppression is possible.

The color separation filter is made by arranging the complementary color filters with large light utilization ratio for white (W), yellow (Y), green (G) and cyan (Cy) in a mosaic, and the part where the yellow and cyan filter are on top of each other becomes a green filter.

This filter is formed on the chip in the process the same as the image sensor shown in Fig. 1-1, so mass-productivity is high and high resolution and high sensitivity have been realized.

4 color signals - white, yellow, cyan and green - are read out independently through the output line, so there is no fear of mixing of colors in the elements, color resolution is good, and interlace scanning with high S/N ratio and without after image is possible.

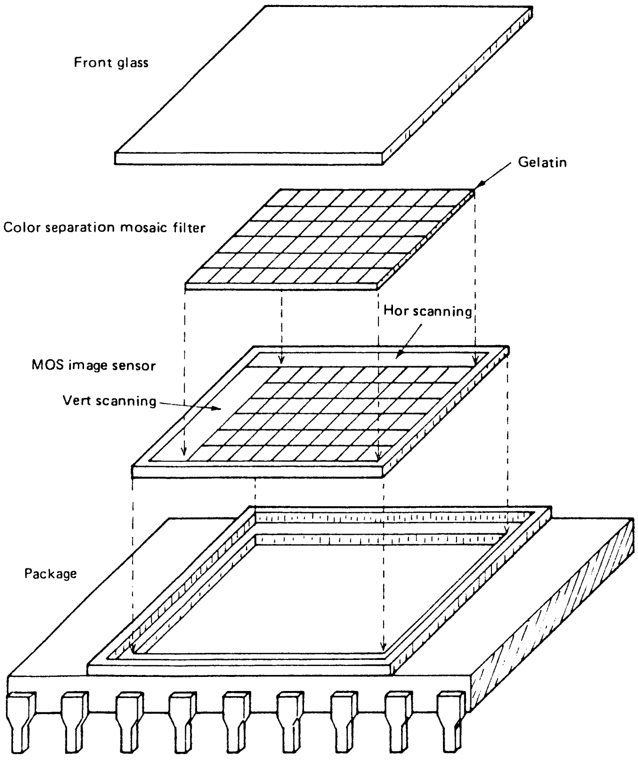

Front glass
Gelatin
Color separation mosaic filter
Hor scanning
MOS image sensor
Vert scanning
Package

Fig. 1-1. Construction of MOS single plate color image sensor

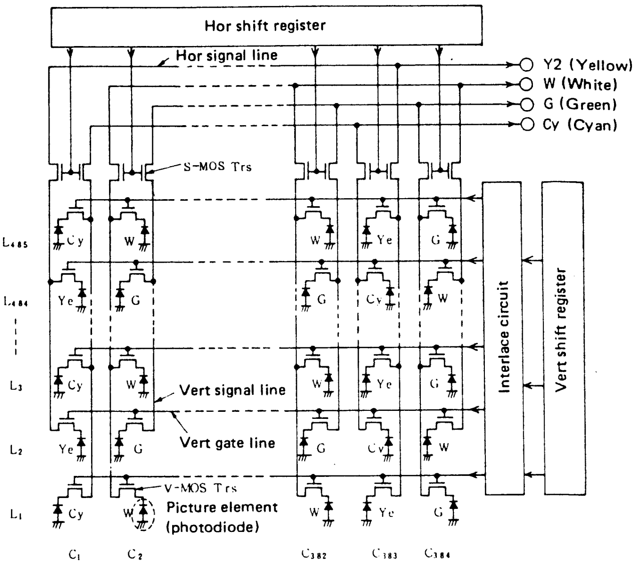

Hor shift register
Hor signal line
Y2 (Yellow)
W (White)
G (Green)
Cy (Cyan)
S-MOS Trs
L485
L484
L3
L2
L1
Cy
W
Ye
G
Vert signal line
Vert gate line
V-MOS Trs
Picture element
(photodiode)
Interlace circuit
Vert shift register
C1
C2
C382
C383
C384

Fig. 1-2. Circuit configuration simulation diagram of MOS single plate color image sensor

(This is the diagram which simulates the plane construction of the image sensor. The 4 color filters (white, green, yellow, cyan) are arranged in a mosaic of picture elements and 4 color signals are taken out independently and alternately using 2 vertical output lines.)

2. Principle of MOS image sensor

Figs. 2-1 and 2-2 show the operation principle of the MOS image sensor. Fig. 2-1 shows the concept of the image sensor simplified to 3 x 3 picture elements. S is the photodiode and G is the gate switch which opens and closes the signal between S and the output using the scanning pulse generated by the scanning circuit (shift register).

1 pair of S and G composes one picture element. This picture element corresponds to 1 MOS transistor with a large source composed of the 2 n layers installed on the P type Si circuit board and the gate electrode which alternately between n layers as shown in Fig. 2-2 (sectional view), and the source (n layer on the left) is concurrently used as photodiode. When light is incident, an electron and positive hole pair is generated in Si; in the n layer, the positive hole flows out to the P type circuit board and electron remains, and in the P type circuit board, the positive hole remains and the electron flows out into the n layer, and these electrons (photoelectrons) are stored in the n layer as a photoelectric conversion signal. The diagram shown at the bottom of Fig. 2-2 is the diagram of electron potential. When a positive pulse is applied to the gate electrode when reading the signal, the barrier of G drops, photoelectron stored in S is taken out to drain D connected to the signal line, and derived outside as an output.

As the positive scanning pulse generated from the vertical scanning circuit opens B in one horizontal row and the scanning circuit opens G just below in sequence from left to right as shown in Fig. 2-1, the photoelectrons of photodiodes S in one horizontal row are taken out as output from left to right and horizontal scanning is done. When the row G which is opened by the vertical scanning circuit is changed in sequence and the same is repeated, the photoelectrons of all the photodiodes are taken out in sequence and scanning of all the picture elements is performed.

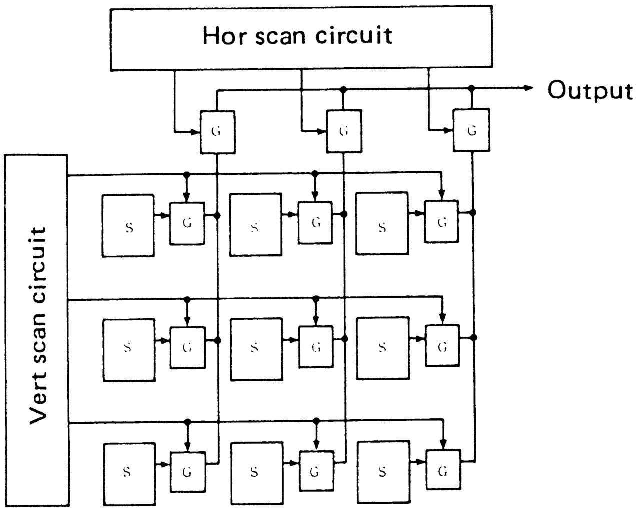
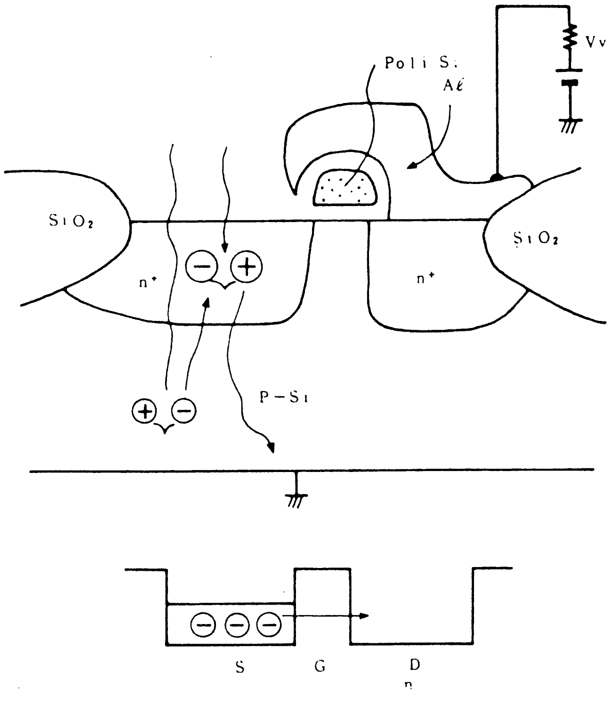


Fig. 2-1 Outline of element



Light →⊕⊖ pair → scattering →⊖ to diode,
⊕ grounded → diode potential (3V→2V→1V)
→V1, H1 set to ON→Output

Fig. 2-2 Sectional view of picture element

2-1 Vertical smear

Vertical smear is the general name of the signals generated when the charge occurs directly on the vertical signal line of the image sensor; it is a typical phenomenon which occurs when light is irradiated on the vertical signal line. Differing from what is called blooming, the amount of vertical smear is proportional to the amount of irradiated light. Vertical smear does not pass through the vertical gate, so it appears as the sum of irradiated quantity of light in the vertical direction regardless of the irradiated position.

Fig. 2-3 is a simulation diagram of the image sensor enlarged up to the picture elements. Arrangement of picture elements W and G, Ye and Cy stand side by side, and in addition, the filters cover the vertical signal lines on both sides. As a result, for example, when light is irradiated on the vertical signal line of W, a vertical smear signal with spectrum of W and G is generated. That is, standard signal W and vertical smear signals ΔW and ΔG are output on the W signal output. It is as shown below.

$$W = W + \Delta W + \Delta G$$

(The same for other 3 lines)

$$\begin{aligned} Ye &= Ye + \Delta Ye + \Delta Cy \\ Cy &= Cy + \Delta Cy + \Delta Ye \\ G &= G + \Delta G + \Delta W \end{aligned}$$

When these signals are processed to produce luminance signal Y and chroma signals R & B as shown below.

$$\begin{aligned} Y &= W + Ye + Cy + G \\ &= W + Ye + Cy + G + 2\,(W + \Delta Ye + \Delta Cy + \Delta G) \\ &= 2Y + 4\Delta Y \\ R &= W + Ye - Cy - G \\ &= W + Ye - Cy - G \\ &= 2R \\ B &= W - Ye - Cy - G \\ &= W - Ye + Cy - G \\ &= 2B \end{aligned}$$

Where, ΔY is the vertical smear signal with the same as spectrum as Y, so the vertical smear signal occurs only in the luminance signal, and not in the R and B signals. In addition, the equivalent quantity is read out not only during the vertical scanning period but also during the period corresponding to the vertical retrace line period, and moreover, the standard signal caused by irradiation of light is not read out during this period, so the vertical smear signal is detected more easily.

Fig. 2-3 (b) shows the condition of vertical smear signal detection and reduction. (a) is the luminance signal including the vertical smear signal shown with oblique lines. The signal within the vertical retrace line period is stored in the memory as shown in (b), and is read out every horizontal period as (c) in the next field.

Signal (d) with vertical smear reduced can be obtained by subtracting signal (c) from signal (a).

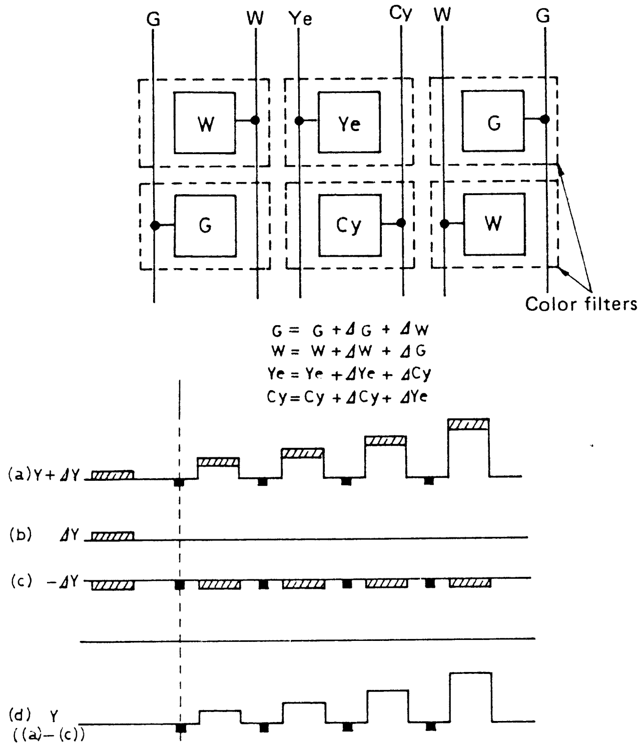

G
W
Ye
Cy
W
G
W
Ye
G
G
Cy
W
Color filters
G = G +ΔG + ΔW
W = W +ΔW + ΔG
Ye = Ye +ΔYe + ΔCy
Cy = Cy +ΔCy + ΔYe
(a) Y + ΔY
(b) ΔY
(c) −ΔY
(d) Y
((a) − (c))

Fig. 2-3 Vertical smear

2-2 Fluctuations in black level caused by dark current and DC offset

The photodiodes of the image sensor generate dark current which depends on temperature, the same as most semi-conductors. In addition DC current called DC offset current is generated. Dark current is dependent on temperature and is generated so as to raise the black level, while DC offset is only slightly temperature dependent and is generated so as to lower the black level. Fig. 2-4 shows the fluctuations of black level caused by dark current and DC offset. Fig. 2-4(a) shows the normal black level without dark current and DC offset. Black level fluctuates as (a), (b), (c), (d) by the DC current and DC offset. That is, low dark current is generated at low temperatures and the black level is affected only by DC offset and as the temperature rises, the effect by dark current grows greater and black level is greatly increased by dark current at high temperatures. The image sensor of this camera employs the complementary color system; when reproducing primary colors by calculation from the complementary color, black balance fluctuates due to the cause described above and the picture quality deteriorates. Fluctuations in black balance due to fluctuations in black level are described in the following. Fluctuations in complementary colors Cy, Ye, W and luminance signal Y and color signals R and B at that time fluctuate due to the following processes.

$$Y + \Delta Y = (W + \Delta) + (Ye + \Delta) + (Cy + \Delta) + (G + \Delta) \rightarrow Y = 4\Delta$$

$$R + \Delta R = (W + \Delta) + (Ye + \Delta) - (Cy + \Delta) - (G + \Delta) \qquad R = 0$$

$$B + \Delta B = (W + \Delta) - (Ye + \Delta) + (Cy + \Delta) - (G + \Delta) \rightarrow B = 0$$

$$G + \Delta G = a(Y + \Delta Y) + b(R + \Delta R) + c(B + \Delta B) \rightarrow \Delta G = a\Delta Y = 4a\Delta$$

Note: a, b and c are G matrix coefficents.

That is, R and B do not fluctuate but only G fluctuates. Accordingly, when the black level fluctuates, black balance moves (1) in the direction of green (+G) when the black level is raised and black balance moves (2) in the direction of magenta (−G) when the black level is lowered. In other words, black balance moves so as to increase brightness due to dark current, that is in the direction of magenta (R + B), so black balance moves in the direction of magenta at low temperatures and in the direction of green at high temperatures.

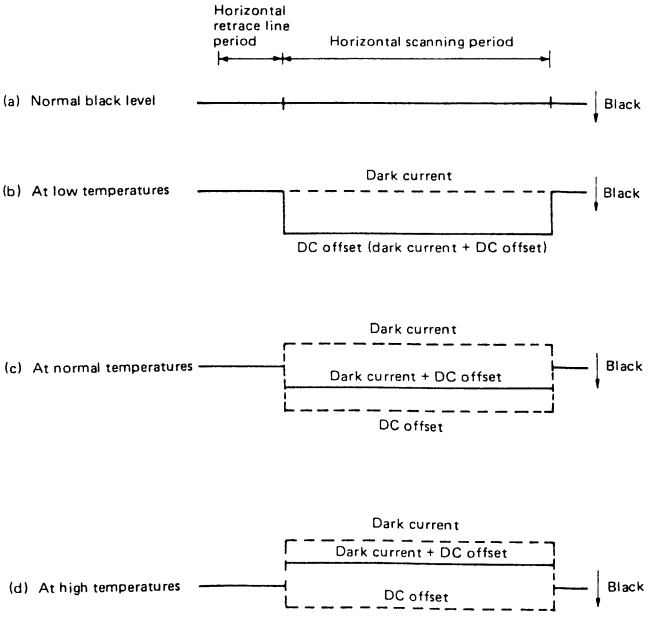

Horizontal retrace line period
Horizontal scanning period
(a) Normal black level
Black
(b) At low temperatures
Dark current
Black
DC offset (dark current + DC offset)
(c) At normal temperatures
Dark current
Dark current + DC offset
Black
DC offset
(d) At high temperatures
Dark current
Dark current + DC offset
DC offset
Black

Fig. 2-4 Fluctuations in black level due to dark current and DC offset

2-3 1.8 MHz fixed noise

1.8 MHz noise appears on the monitor screen as 1.8 MHz vertical stripes especially when viewing red pictures. The cause of generation is unevenness of mask-matching of the image sensor. The cause of generation is simulated in Fig. 2-5. The figure shows arrangement of the photodiodes of the image sensor and the filters. 4 picture elements Cy, Ye, W and G are arranged with top and bottom inverted every 4 picture elements and Cy and Ye, W and G are simultaneously read out and luminance signal Y = Cy + Ye = W + G is obtained. Top and bottom are inverted every 4 picture elements, so, observing Cy for example, Cy (A) shown in this diagram is connected to the vertical signal line on the right but Cy (B) read out next is connected to the vertical signal line on the left.

Assuming that mask-matching drifts and sensitivity of Cy (A) changes by $-\alpha$, the sensitivity change of Cy (B) is $+\alpha$. Respective sensitivity changes of Ye, W and G are β, γ, δ, at that time. As a result, the change component of the luminance signal becomes the fixed signal with horizontal direction 4 picture element period as shown in the diagram. The luminance signal is read out at 7.2 MHz, so the above fixed signal frequency is 1.8 MHz. This is the 1.8 MHz fixed noise; this is caused by unevenness of sensitivity and it is proportional to incident light quantity and occurs with wavelength dependability due to the unevenness factor. To cancel this, a 1.8 MHz signal corresponding to the wavelength and proportional to quantity of incident light is produced by the L circuit board and added it to the signal.

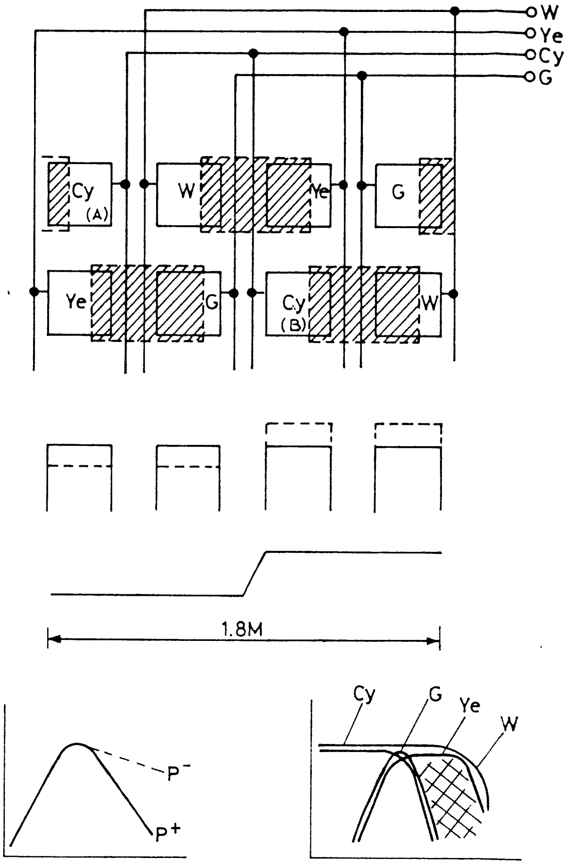


Fig. 2-5 1.8 MHz fixed noise

3. Description of each circuit operation

3-1 Preamplifier circuit

The preamplifier is composed of hybrid ICs HT5101 (IC103, 104), HT5102 (IC101, 102); it detects a weak signal from the MOS image sensor and facilitates signal processing thereafter. The signal from the image sensor is a constant current power supply and is low as approx. 200 μA, so overall S/N ratio is determined by this preamplifier. This preamplifier requires to read out the signal within the 7.2 MHz clock period (140 nS) so sufficient NFB with an impedance of approx. 500Ω is applied. Feedback is applied as direct current as is seen in Fig. 3-1, the voltage fed back to the FET gate becomes video bias of the image sensor.

The switching pulse of the horizontal switch MOS of the image sensor leaks into the signal line as a regulated power supply exceeding the dynamic range of the preamplifier and degrades picture quality in such as black level fluctuation, etc., so the cancelling signal CLC is input from the FET drain via the capacitor. In addition, the signal component is taken out together with the narrow band characteristics of the amplifier while fully suppressing the clock component.

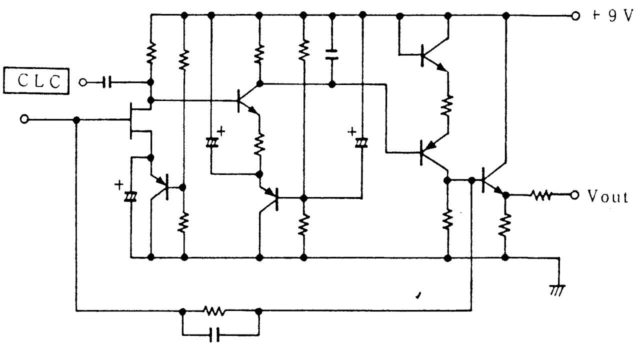


Fig. 3-1

3-2 Matrix circuit

4 signals - W, Ye, Cy, G - output from the preamplifier are converted into the signal Y and chroma signal R & B through the matrix circuit (IC105 HT5109).

$$Y = W + Ye + Cy + G = 2(2G + B + R)$$
$$R = W + Ye - Cy - G = 2R$$
$$B = W + Cy - Ye - G = 2B$$

Y, R, B signals obtained by this conversion are band-limited and then input to the intergrating IC107 (HA-11730).

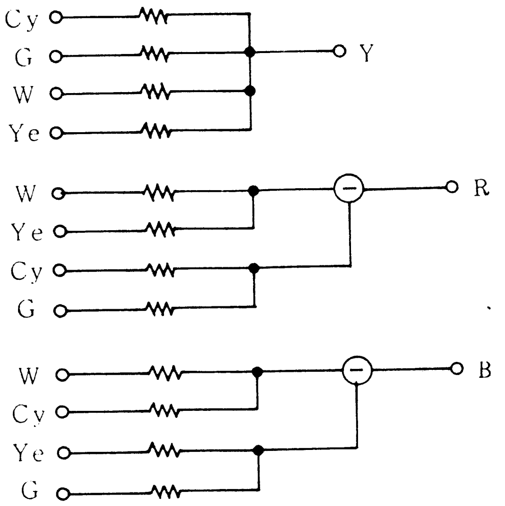

Cy
G
W
Ye
Y
W
Ye
Cy
G
−
R
W
Cy
Ye
G
−
B

Fig. 3-2

3-3 Integrating circuit

The integrating IC is IC107 (HA11730), and its block diagram is shown in Fig. 3-3.

The signals converted into Y, R and B through the matrix circuit are input via pins 4, 9, 24 and amplified by 26 dB, 32 dB and 38 dB respectively through roughly the same circuits. With this IC, the fixed pattern noise (FPN) can be reduced approximately 20 dB.

Actually, 500 kHz will do for the R and B color bands finally and signals at 500 kHz or less are so small and can be ignored, so integrating pulse HiR is applied only to Y channel via pins 1 and 28 to suppress FPN.

The signal current ratio among Y, R, B changes depending on unevenness of spectral sensitivity characteristics of the image sensor and color demodulation matrix, so gain of R and G is adjusted by RT102, RT103 so that these changes can easily be absorbed.

A narrow band preamplifier is used in this system to reduce the clock noise as described in the item "pre-amplifier" previously, and the band is lacking for the Y channel, so a resistor and capacitor are connected between pins 6 and 7 to apply reverse compensation.

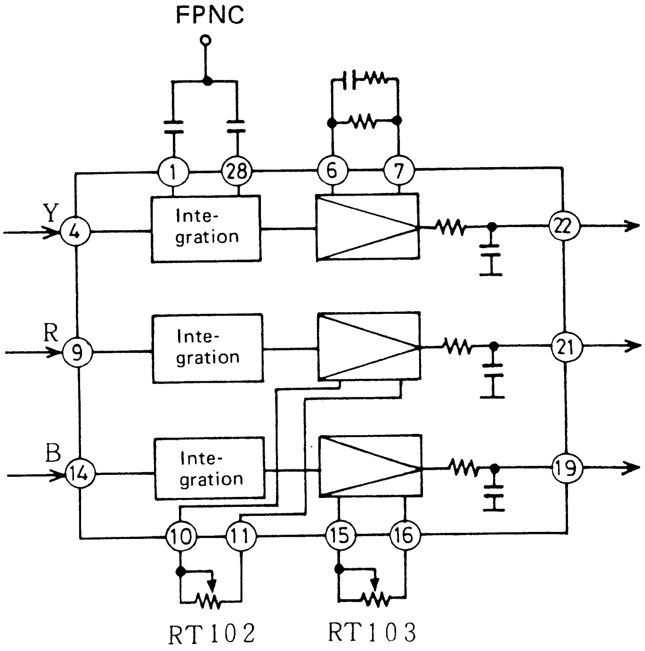

FPNC
1
28
6
7
Y
4
Inte-gration
22
R
9
Inte-gration
21
B
14
Inte-gration
19
10
11
15
16
RT102
RT103

Fig. 3-3

3-4 Process IC201 (HA11731)

This IC inputs R, B, Y signals of approx. 250 mVp-p which are the output signals from the P circuit board for the following signal processing.

(1) White balance correction
(2) γ correction (3) Clamp
(4) White clip (5) Blanking
(6) Color difference matrix
(7) AGC

The circuits for R, B, Y channels are integrated in one IC.

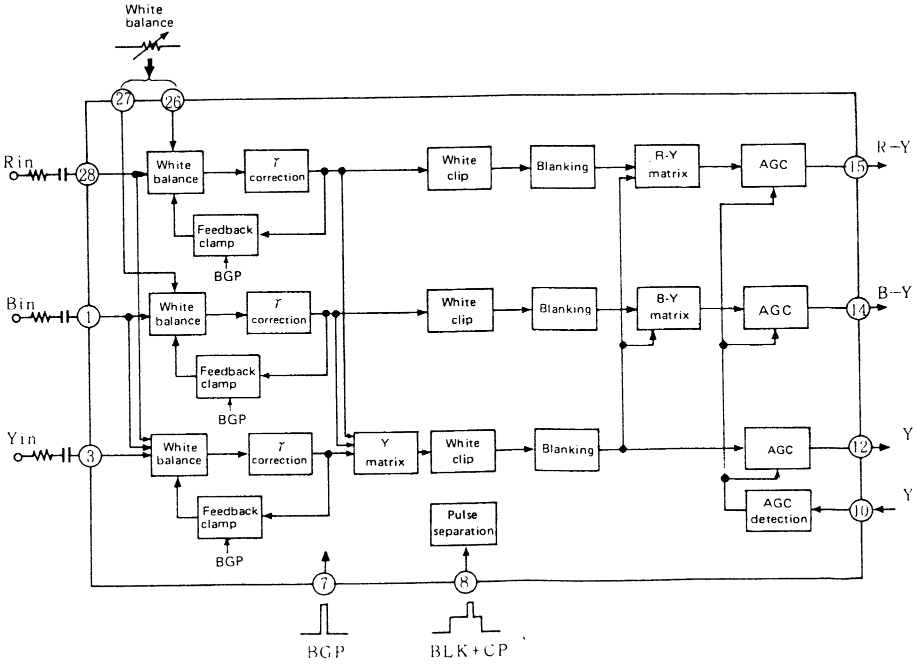

White balance
27
26
Rin
28
White balance
γ correction
Feedback clamp
BGP
White clip
Blanking
R-Y matrix
AGC
15
R−Y
Bin
1
White balance
γ correction
Feedback clamp
BGP
White clip
Blanking
B-Y matrix
AGC
14
B−Y
Yin
3
White balance
γ correction
Feedback clamp
BGP
Y matrix
White clip
Blanking
AGC
12
Y
AGC detection
10
Y
Pulse separation
7
8
BGP
BLK+CP

Fig. 3-4 Process IC (HA11731) internal block diagram

(1) White balance correction

The variable gain amplifiers (variable range: +6 dB) are provided in the initial stages of the R and B channels. Gain control characteristics are mutually compensated (seesaw) in R and B channels. Good white balance correction within a wide color temperature range of 2500° K - 8500° K is possible with one VR.

(2) γ Correction

The MOS sensor is : $\gamma = 1$, so the γ correction circuit is set to $\gamma = 0.5$. Correction is done moderately to improve the S/N ratio in low luminance sections.
Refer to the VK-C800 service manual No. 1523E for the circuit configuration.

(3) Feedback clamp

It is required to fix the black level which is to be the reference of the signal by direct current, when performing gamma correction or white clip signal processing. The black level fluctuation in the output of the gamma correction circuit is sample-held by BGP, and the output obtained by comparing and amplifying this voltage and the clamp potential (pins 17, 18, 19) is fed back to the input to fix the black level of the input signal. Refer to VK-C800 service manual No. 1523E for the circuit configuration.

(4), (5) White clip, blanking

Rating of the video signal level is specified. When the level exceeds this value, picture quality deteriorates or the VTR cannot operate normally.
Sync noise is mixed in the output signal of P circuit board during the BLK period due to interruption of the MOS sensor drive pulse, etc. As a result, the white clip circuit is provided to remove the sync noise during the blanking period so that the output level of the camera is always within the rating.

(6) Color difference matrix

(R-Y) signal is produced from the R and Y signals, and (B-Y) signal, from the B signal and Y signal.

(7) AGC

When brightness of the object changes, the auto-iris of the lens operates and the video signal level of the MOS sensor output starts dropping. AGC starts operation at this time to keep the output level of the process IC constant. Amount of AGC is approx. 6 dB.

(8) AGC detection

The above AGC circuit is controlled by the output produced by comparing and amplifying the Y signal input waveform of the encoder IC (HA11720MP) and the reference voltage.

(9) G matrix & Y matrix

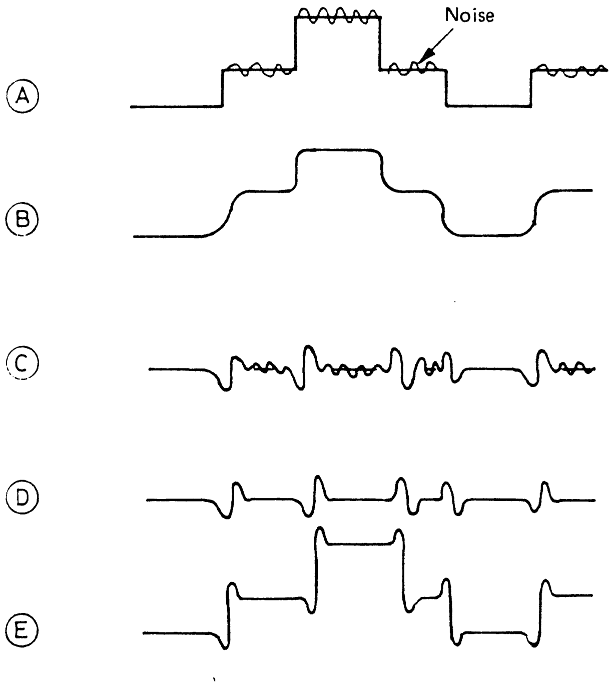
It is recommended to apply γ correction to the Y signal after converting it to the B signal, and returns it to Y signal again; this causes good color reproductivity. So, this IC incorporates G matrix which produces G signal from R, B, G signals after γ correction to improve color reproductivity.

(10) Pulse separation

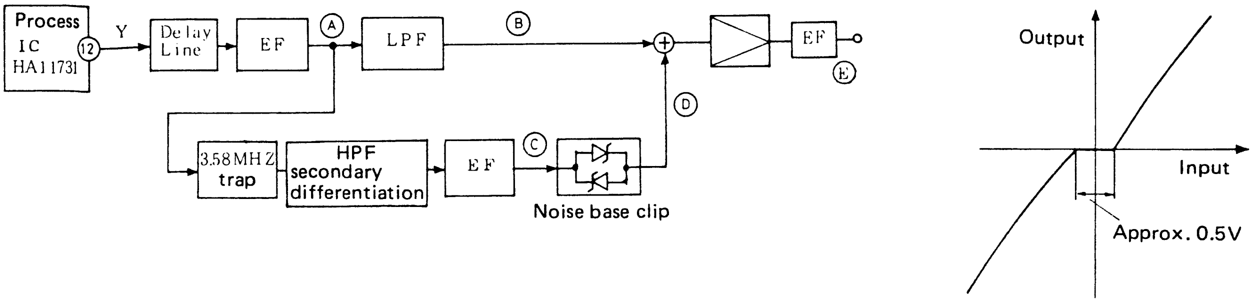
Blanking pulse (BLK) and clamp pulse (CP) are mixed and supplied to pin 8 and then separated inside the IC again. By this, one IC pin can be reduced, which is useful for integrating many more functions.

3-5 Aperture compensation, noise base clip circuit

Emphasis of picture outline and noise reduction processing are applied to the luminance signal Y output from the process IC, by the aperture compensation circuit and noise base clip circuit. This is described in Fig. 3-5.
The Y signal output A of the process IC is the waveform which contains noise in its signal as shown in the diagram. When this is divided into the low frequency signal B which has passed through LPF and the high frequency signal C which has passed the secondary differential HPF, almost all noise appears in the high frequency signal C as shown in the diagram. When this is passed through the noise base clip circuit, the high frequency signal D with its noise base clipped due to the input/output characteristics shown in the diagram is obtained. The low frequency signal B and the high frequency signal D with its noise base clipped are added and amplified, and the Y signal E with noise suppressed and emphasized picture outline is obtained.



Waveform of each section



Input/output characteristics of noise base clip circuit

Fig. 3-5

3-6 Encoder circuit

The encoder circuit is composed of IC202 HA11720MP and performs NTSC modulation. This is the same as HA11720 used for VK-C750, VK-C800, etc., so refer to the service manual No. 1523E for details.

3-7 Vertical smear and 1.8 MHz flicker reduction circuit

As described in item 2-1 "Vertical smear", vertical smear is generated in the luminance signal. An equivalent quantity is read out not only during the vertical scanning period but also during the period equivalent to the vertical retrace line period. So, Y signal containing vertical smear within the retrace line period is derived from the input process as shown in Fig. 3-6 (Block diagram), and it is analog/digital converted using the 4-bit A/D converter (HA19201 x 2). This digitized vertical smear is stored in the memory of the vertical smear reduction IC HD44040 and output in the horizontal scan of the next field, and is applied to the primary signal with reverse polarity to cancel the vertical smear.

At the same time, phase and amplitude of the 1.8 MHz signal are changed by RT401 and RT402 to cancel the 1.8 MHz flicker.

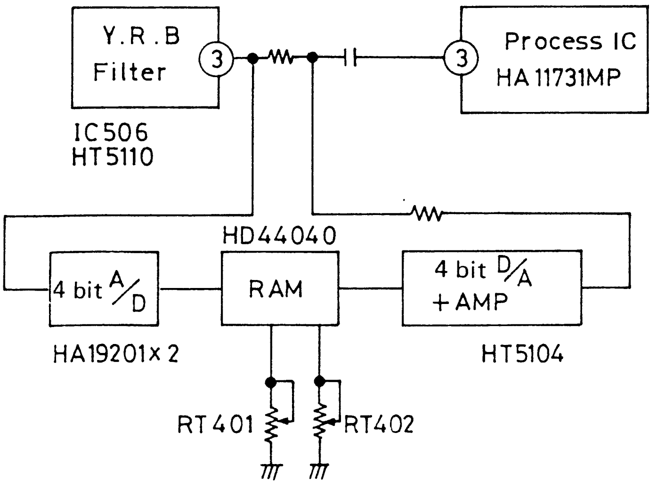


Fig. 3-6

3-8 Dark current, offset correction circuit

As described in item 2-2, dark current is temperature dependent and acts to raise black level by increasing temperature and DC offset is not temperature dependent and acts to lower the black level.

So, from the fact that dark current changes exponentionally, the change of the collector current of the transistor caused by temperature is detected and dark current is made to act to lower the black level, and DC offset is made to act to raise the black level by a certain quantity because DC offset has temperature dependability.

Fig. 3-7 shows the correction circuit. The DC offset circuit inputs the V_1 pulse from RT105 and raise the black level by the equivalent amount while matching with the DC offset quantity. The dark current correction circuit inputs the V_2 pulse from the base of Q107, and raises and lowers the blanking level corresponding to its dark current using RT104 to correct the black current detecting the change of the collector current caused by the temperature of Q103.

3-9 1.8 MHz fixed noise canceller circuit

As described in item 2-3, the 1.8 MHz fixed noise is proportional to quantity of the red signal, so it is cancelled by subtracting the signal with the phase same as that of the 1.8 MHz fixed noise, produced by balance-modulating the 1.8 MHz clock signal, from the luminance signal. Fig. 3-8 shows the block diagram of the canceller circuit, and the luminance signal at point A output from the integrating IC107 (HA11730) contains the 1.8 MHz fixed noise proportional to the red signal at point B.

The 1.8 MHz with the same phase and amplitude as this fixed noise is adjusted by RT405 and RT406, supplied to the balanced modulator, and by subtracting this from the luminance signal at point A, the waveform at point D without 1.8 MHz signal can be obtained.

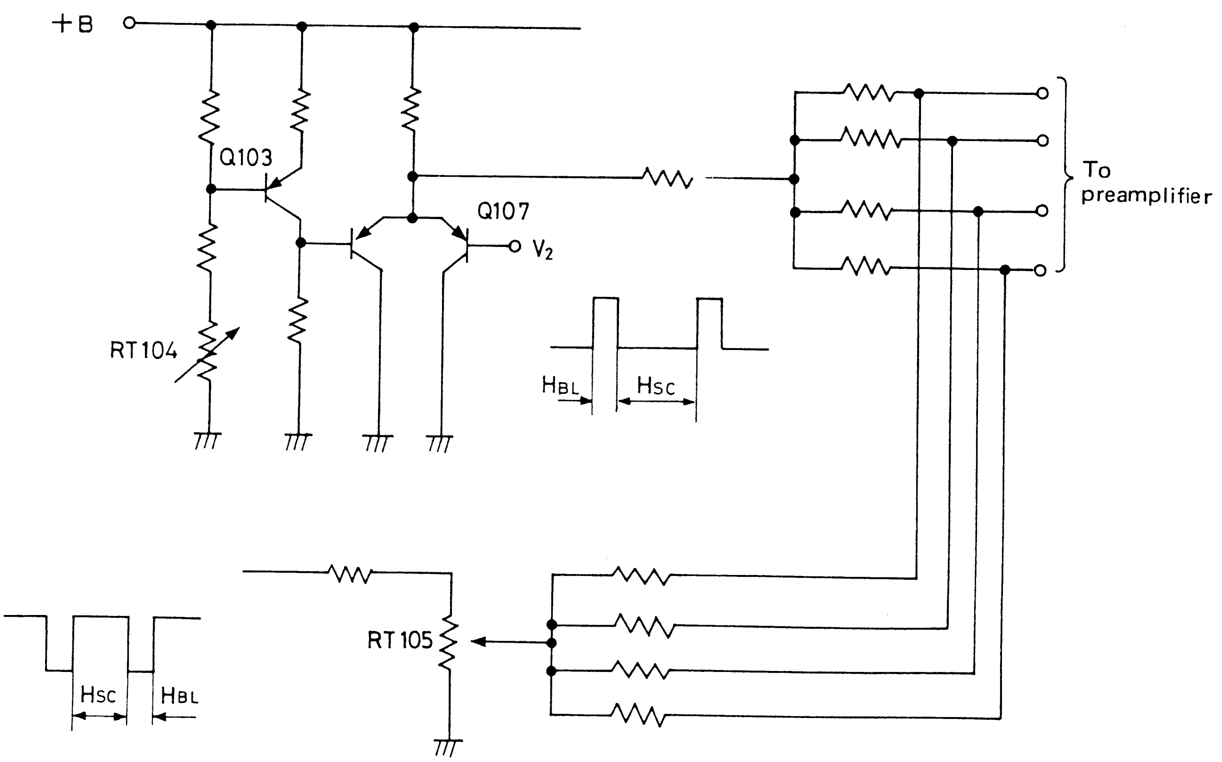

+B
Q103
Q107
V2
RT104
To preamplifier
HBL
HSC
RT105
HSC
HBL

Fig. 3-7

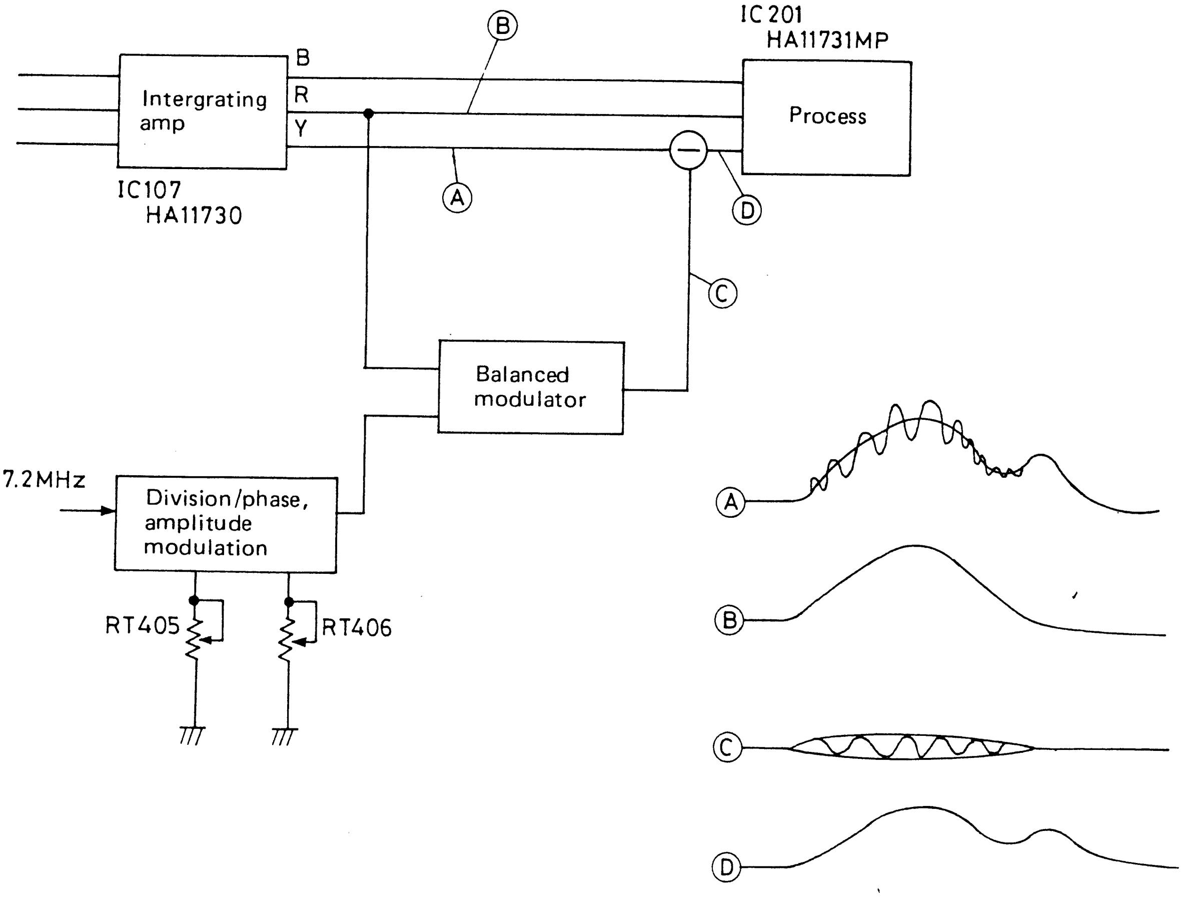

Intergrating amp
B
R
Y
IC107
HA11730
Ⓑ
IC201
HA11731MP
Process
Ⓐ
Ⓓ
Ⓒ
Balanced modulator
7.2MHz
Division/phase, amplitude modulation
RT405
RT406
Ⓐ
Ⓑ
Ⓒ
Ⓓ

Fig. 3-8

3-10 Power save circuit

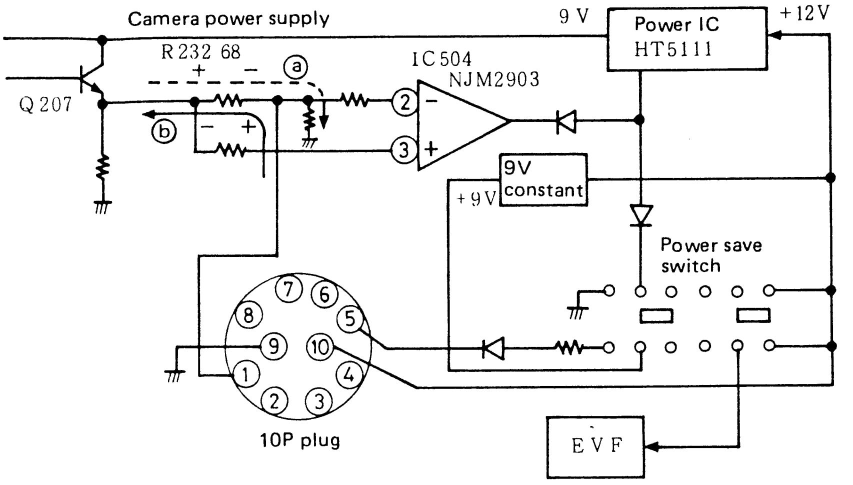


Fig. 3-9

The power save circuit sets the power IC HT5111 and the EVF power to OFF when the feedback video signal is output to pin 1 of the 10P plug by means of control from the VTR, or when the power save switch is set to ON from the camera to save the power consumption of the VTR and camera.

Fig. 3-9 shows its construction. When the video output is sent to the VTR from NTSC output Q207 of the camera, the emitter of Q207 is set to approx. 2V DC level and current flows along route a and potential is set as shown in the diagram, and the output level of IC504 NJM2903 is set to "1". At the same time, when the video signal is fed back from pin 1 of the VTR, current flows along route b , potential input to NJM2903 is set to reverse polarity, its output level is set to "0" and is supplied to the control pin of power IC HT5111 and shuts off the 9V output. When the VTR with which the video signal is fed back from pin 3 is used, the camera is not set to the power save mode. On the other hand, when the power save switch is set to POWER SAVE, the "0" level is input to the control pin of HT5111 in the same way and the 9V output is shut off. Power supplied to EVF is also shut off at that time, and the "1" level is input to pin 5 of AUDIO OUTPUT impedance 3.3 kΩ to apply power save to the VTR.

3-11 Audio amplifier circuit

The audio amplifier circuit amplifies the audio signal from the microphone and supplied it to the VTR; and uses IC505 HA1406.

This system uses an exclusive detachable microphone and amplifies the electret condenser microphone with a sensitivity of −65 dBs to −20 dBs. The circuit is as shown in Fig. 3-10. When an external microphone is connected, the exclusive microphone connected to the INT microphone jack is switched over to the external microphone.

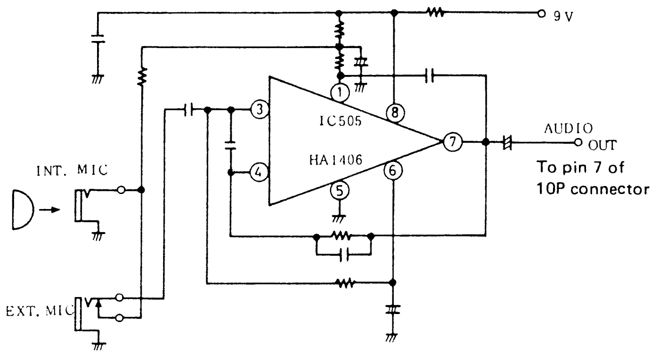


Fig. 3-10

3-12 Audio return circuit

The video signal of the VTR can be monitored using the electronic viewfinder. The audio signal can be monitored by connecting an earphone. The signal input from AUDIO IN at 0 dBm as shown in Fig. 3-11 is attenuated by approx. 20 dB and is output to the earphone jack.

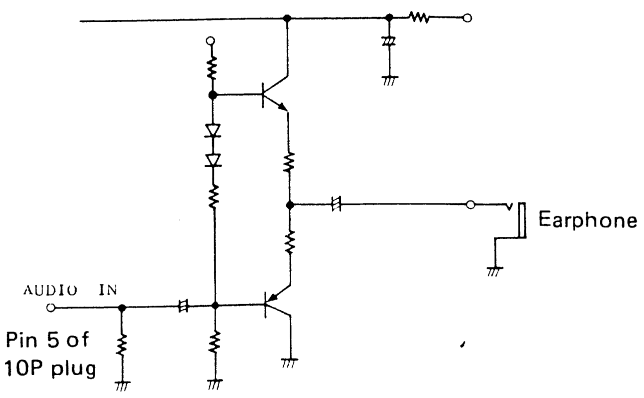


Fig. 3-11

3-13 VTR trigger circuit

This circuit is composed of IC502 HT5106. This is the bistable flip-flop shown in the block diagram and the switch selection is provided so that it can correspond to VTRs which are controlled at pause "HIGH" and pause "LOW". Fig. 3-12 shows the block diagram.

REC9 is set to "0" by the record operation from VTR, pin 3 of IC502 HT5106 is set to "0" level, inverted by the driver circuit and the "1" level is output from pin 6 of 10P plug. As a result, the VTR which is controlled by pause "HIGH" is set to the PAUSE mode. Next, every time the trigger pulse is input from VTR SW, the pin 3 output inverts and the PAUSE release record PAUSE operation are repeated. The same operation is done with the pause HIGH/LOW select SW set to the position opposite to the position shown in the diagram on the VTR which is controlled by pause "LOW". Here, the V display control signal is the identification signal of record and non-record, and it indicates recording and lights the V indicator at "1" level. (Refer to the display circuit for details).

To let the VTR start in the PAUSE mode after power save operation, the "0" level is output from pin 3 by the diode shown in the diagram after the power save operation.

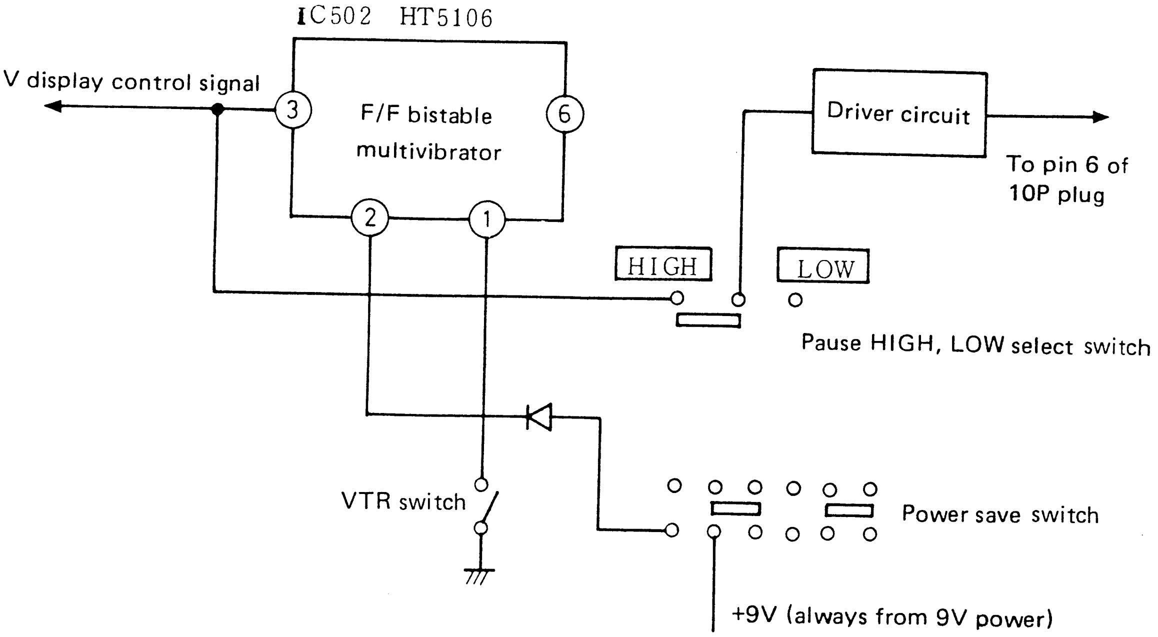

IC502 HT5106
V display control signal
3
F/F bistable multivibrator
6
2
1
Driver circuit
To pin 6 of 10P plug
HIGH
LOW
Pause HIGH, LOW select switch
VTR switch
Power save switch
+9V (always from 9V power)

Fig. 3-12

3-14 Display circuit

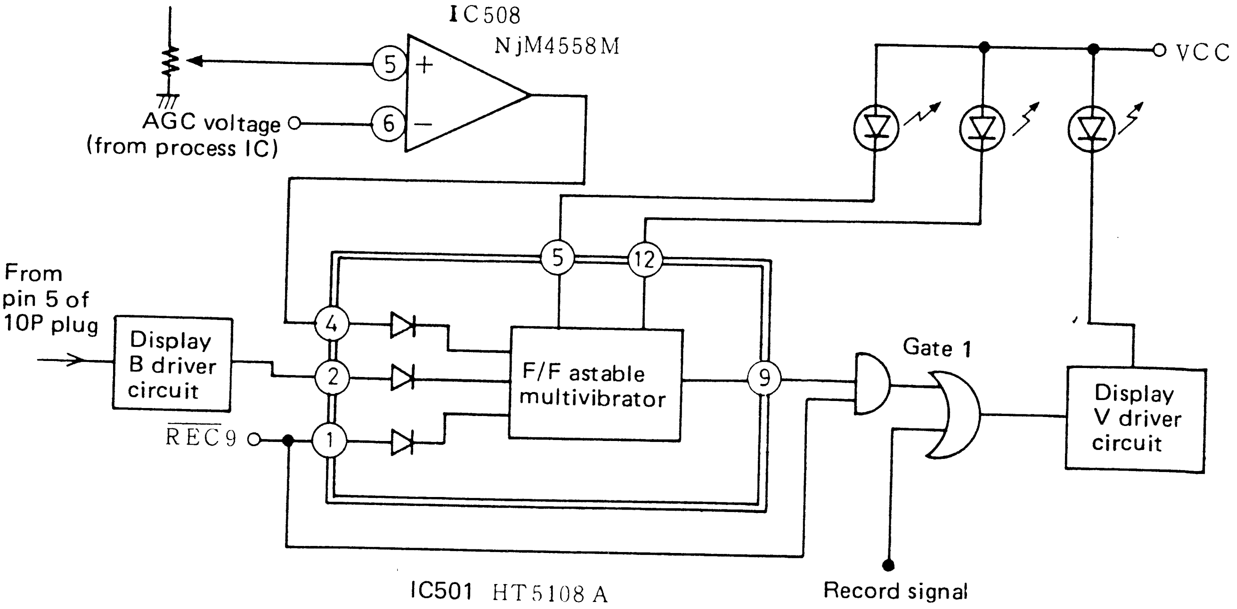

IC508
NjM4558M
5
6
AGC voltage
(from process IC)
VCC
From pin 5 of 10P plug
Display B driver circuit
REC9
4
2
1
5
12
F/F astable multivibrator
9
Gate 1
Display V driver circuit
Record signal
IC501 HT5108 A

Fig. 3-13

The display circuit of VK-C1000 indicates inside the EVF using 3 LEDs - V display which indicates recording and non-recording and L & B displays which flash during underexposure and battery low. Fig. 3-12 shows the block diagram. IC501 HT5108A is an astable multivibrator; when "1" level is input from pins 1, 2, 4, it oscillates and outputs the oscillation frequency (approx. 0.5 - 2 Hz) to pins 5, 9, 12. The display V driver circuit drives LED V when the "1" level is input from Gate 1. Display B which lights during battery low detects the DC potential (1.2V - 2.0V) which is superimposed from pin 5 of 10P plug AUDIO IN when battery is low, and supplies the "1" level to HT5108A pin 2 to flash LED of display B. The underexposure display compares the set potential and the AGC voltage (Process IC HA-11731MP pin 9) which changes due to illumination and supplies the "1" level to HT5108A pin 4.

As for the recording display of display V, the display V driver circuit when the RECORD signal produced by the V trigger circuit is input at "1" level, but when REC9 is set to "1" level (modes other than REC and REC/-PAUSE), astable multivibrator HT5108A is operated the same as in L & B, to flash the V display.

HOW TO READ ABBREVIATIONS

AGC DET	AGC detection signal
B	Color signal BLUE
BLK	Blanking pulse
BF	Burst flag pulse
BGP	Black gate pulse
CLC	Clock cancel signal
CLK 7.2 MHz	7.2 MHz clock pulse
CLK 14 MHz	14 MHz clock pulse
COMP. ⊕	Comparison signal ⊕
COMP. ⊖	Comparison signal ⊖
Cy	Color signal CYAN
CP	Clamp pulse
DIS V	V (Recording indicator) display
DIS L	L (Underexposure indicator) display
DIS B	B (Battery charge indicator) display
EVF +12V	Electronic viewfinder +12V
FC	Flicker cancel signal
F. F 1	Flip flop No.1 (Positive trigger)
F. F 2	Flip flop No.2 (Negative trigger)
FPNC	Fixed pattern noise cancel pulse
G	Color signal GREEN
HBF	Horizontal burst flag pulse
HP 1	Horizontal pulse No.1
HP 2	Horizontal pulse No.2
IRIS DET	Iris detection signal
MP	Memory pulse
NTSC DIS	NTSC discrimination signal
NC	Not connected
PS +12V	Power save +12V
PS +9V	Power save +9V
PS 1	Power save No.1
PS 2	Power save No.2
REC 9	Recording +9V
$\overline{\text{REC}}$ 9	Except recording +9V
R	Color signal RED
SYNC	Synchronize signal
SC	Sub carrier
T/W ⊕	Tele, Wide drive power ⊕
T/W ⊖	Tele, Wide drive power ⊖
VPS	Vertical smear pickup signal
VCS	Vertical smear cancel signal
VDP	Vertical drive pulse
VIDEO I/O DIS	Video In/Out discrimination signal
VP 1	Vertical pulse No.1
VP 2	Vertical pulse No.2
WHD	Wide horizontal drive pulse
W	Color signal WHITE
WB	White balance check signal
WBC	White balance control signal
Y	Luminance signal
Ye	Color signal YELLOW